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OOKS" of the
FIRE PREVENTION COMMITTEE.—No. 236
by the Executive.

FIRE PREVENTION
AND PROTECTION

AS EXEMPLIFIED IN AN

ENGLISH FACTORY

BY

STANLEY W. THORPE

Chief Officer Kodak Fire Brigade

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LONDON, 1919
Published at the Offices of
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897. Incorporated 1899)
8 WATERLOO PLACE, PALL MALL, S.W.1

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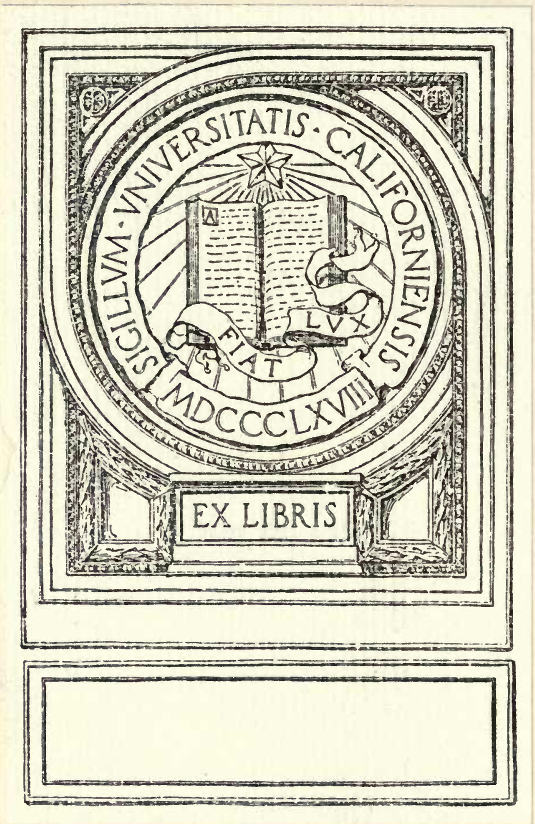
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"RED BOOKS" of the
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OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimizing the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library, and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Report on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticism, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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OF THE

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NOTE

The British Fire Prevention Committee has always advocated that the main principle of Fire Prevention should be followed by that of providing a first-aid fire equipment, as it recognizes the fact that notwithstanding the adoption of the most careful precautions, accidents will occur, and whilst such accidents may not unduly expand into serious calamities, if adequate preventive measures have been taken, yet it is assuredly advisable to prevent any such expansion by the provision of suitable fire-extinguishing appliances and some organized form of Self-Help for immediate application.

The Committee has, from time to time, been the recipient of observations to the effect that its recommendations partake of an extremist character and are not economically feasible. It is, therefore, gratifying to the Committee to find that an English factory has of its own initiative adopted many of the ideas it is continually recommending.

Accordingly the Committee made representations to Messrs. Kodak, Ltd., of Wealdstone, Middlesex, inviting them to instruct the Chief Officer of their efficient Fire Brigade—Mr. Stanley W. Thorpe—to write a short " Red Book " on the subject. Messrs. Kodak, Ltd., cordially accepted this invitation and allowed Mr. Thorpe to include a large number of illustrations of the methods adopted in their Works.

The British Fire Prevention Committee desires to tender them, and Mr. Thorpe, its sincere thanks for this much appreciated co-operation in its humanitarian and national efforts to prevent the terrible wastage of life and property by the ravages of fire.

The Committee wishes to emphasize that it does not necessarily agree with all that is stated in the " Red Book," nor does it admit that all that is practically possible to be done in this direction has been carried out at the Kodak Works, but it feels that many large industrial establishments will be glad to learn what is readily possible in the way of Fire Prevention and Self-Help.

Issued by Order of the Executive.

Offices of
The British Fire Prevention Committee,
8, Waterloo Place, Pall Mall,
London, S.W.1.
August, 1919.

FIRE PREVENTION AND PROTECTION AS EXEMPLIFIED IN AN ENGLISH FACTORY.

THE enormous waste and destruction together with serious loss of life each year from fires, causes one to stop for a moment and consider if something more cannot be done in these enlightened times to prevent such disasters to the community at large. Owners and managers of large works and business houses, who have staffs of many hundreds of employees working for them, have a great responsibility as regards the safety of their employees' lives in connection with fire, entirely independent of what the result might be to their business should their establishment containing papers, records, stock, machinery, etc., be destroyed by fire, and their whole business thrown out of gear for perhaps many months before the damage can be rectified and such machinery obtained.

The subject resolves itself into two parts—Firstly, Fire Prevention, which stands out largely as the more important and worthy of primary consideration. Fire prevention means the elimination of all means by which a fire can start, and the construction and arrangement of buildings in such a manner as to prevent the spread of a fire and the provision of properly constructed and adequate means of escape for the employees. Secondly, Fire Protection by means of suitable First Aid fire appliances properly placed and of sufficient number to efficiently deal with any small outbreak of fire, and especially in large works situated some way out on the outskirts of towns, or in country districts, the provision of a thoroughly equipped, efficient and up-to-date Fire Brigade of their own, competent to deal with any outbreak of fire which might possibly occur. Each of these two divisions will be dealt with in turn.

Fire Prevention.

Fire prevention may again be subdivided into two sections, Structural and Internal. As regards the structure, the provision of adequate fire exits is of first importance in every factory or building in which a large number of employees is engaged. It is essential that they should be provided with panic bolts and that the doors should either swing or open outwards. In providing outside fire exits care must be taken that these exits are built in such a manner that they will be available should a fire occur. Many of these outside fire exits pass in front of windows on lower floors, and if these are glazed with the ordinary glazing and wood casements, it is more than likely that they will be useless when required owing to the fire having destroyed the windows and the heat being so great that no one can pass down them. In such cases this can be overcome by means of steel casements and wired fire-resisting glass. Fig. 1 illustrates such an exit passing in front of windows which have been treated in this manner. The small windows in the centre which open are provided with a cord and a fusible metal link which gives way when the temperature rises. Windows in front of fire exits should not, of course, be the only ones so treated with steel casements and wired glass, but every window opening adjacent to another building, so as to prevent the spreading of a fire from one building to another, which often happens when windows are not protected in this way.

Difficulty is frequently met with in providing outside fire exits owing to space being limited. Fig. 2 illustrates a very excellent way of getting over this difficulty by means of having the lower half of the stairway hinged and connected to a counterbalance weight. When not in use the whole can be pushed up clear of the pavement, and when required, the very act of people passing down causes it to gradually sink down to the ground. Having provided the necessary fire exits it is essential that the employees should have a thorough training as to the proper and correct method of leaving the building. Fig. 3 illustrates the incorrect method. It will be noticed that the skirts of the girls trailing on the steps are apt to be trodden on by the girls following, and therefore are liable to cause one to trip over in the press of others following, and so is likely to cause disaster. This can easily be overcome by means of a little training, and Fig. 4 illustrates the correct method of leaving the building. The girls are required to march down two by two, one holding the handrail with the right hand and her skirt round her with the left, and the girl next should hold the arm of the girl on her right and her skirt with the left. By keeping on the right-hand side of a stairway, room should be provided for the fireman to pass up on the other side. With a little practice it will be found that this can soon be perfected and a large building speedily emptied. When iron outside doors are fixed to fire exits it is important that some means should be provided whereby the key can be instantly obtained to gain access should it be necessary. To get over this difficulty the key should be kept outside in a small wooden box with a glass front; and in the case of emergency, by breaking the glass, the key is instantly at hand; see Fig. 5.

Every care should be exercised in constructing buildings to make them fire-resisting in every conceivable way, and the importance of sub-dividing the buildings by means of substantial party walls as frequently as possible is now well realized by almost every one, but in providing such party walls it is useless unless they are perfect party walls, namely, carried right up and well through the roof. Care must also be taken that no holes are left such as by the removal of a pipe, otherwise the fire may be conveyed through to the next section. All wall openings in such party walls should be provided with reliable fire-resisting doors. Fig. 6 illustrates a sliding metal covered door which is kept open by a weight attached to a cord running over a pulley; to this is connected a fusible link which parts when the temperature rises, and if not already closed the door automatically closes itself. Such a door, however, must be specially constructed in compliance with recognized rules and not just an ordinary door with pieces of tinned iron nailed on. A door such as the latter would be relying on false security. It is also important to see that the door is properly hung, that when the weight is lifted it will automatically close, without being touched, into the proper stops and roller guide provided to keep the door close up to the wall when closed. Double fire-resisting doors should be fitted, one on either side of the opening; this provides a good air space between the two doors, which has a most decided cooling effect, and thus provides double protection. It is important, of course, to see that the sill is of brick, stone or concrete, otherwise the fire may work underneath the doors. Another very important point to consider is the proper protecting of lifts or hoists. These are often put in without being enclosed and when a fire occurs the whole of the building is destroyed, in fact what may be termed a chimney is provided to convey the fire from top to bottom of the building. All such lifts must be enclosed in a brick-built well, carried up clear through the roof and the opening on each floor protected by a fire-resisting door. If care is taken in this way a fire which would otherwise destroy the whole building may be confined to one section.

The installation of automatic sprinklers throughout, it is needless to say, adds a great deal to the security of a building. Two sources from which a reliable water supply can be obtained are essential. Water is generally obtained from the public water supply and elevated tanks or by means of pumps to which is connected a rising main of suitable size; lines of horizontal distributing pipes are fixed at intervals of 8 to 10 ft. along the ceiling of each room to which are attached the sprinkler heads. These really consist of valves kept closed by a glass jet or metal disc held in position by a strut made up of several pieces of metal joined together with fusible solder, or two levers held in tension by means of a fusible link. When the temperature rises the fusible solder gives way and the water rushes out, impinges upon the deflector and drenches everything within reach. Small fires are therefore held in check, and the alarm bell, which is installed in connection and which is worked by means of a small water motor, commences to ring immediately the water starts to pass, giving instant warning. It is therefore practically impossible for a fire to burn for any length of time in a building so protected without warning being given and water automatically poured upon the fire. Spare heads would, of course, be kept in stock so that should an accident occur another could at once be screwed into its place. If a Works' Salvage Corps is provided, as recommended in another part of this book, damage from a sprinkler accidentally set in action can be reduced to a minimum.

Rooms constructed of fire-resisting material should be provided for employees to hang their clothes in, and care should be exercised that they are hung nowhere else, otherwise men coming into the factory and hanging their coats up in some odd corner may leave a pipe alight in a coat pocket; this burns through the lining, falls on some combustible material and a fire is set going, often in some out-of-the-way place where it may get well away before being seen.

Insufficient care is exercised in the majority of factories in storing oil, petrol and other combustible liquids. The provision of a special store for combustibles, situated well away from all other buildings, is an absolute necessity. The floor of this store should be below the level of the ground so that in case of a fire, should the receptacles holding the inflammable liquids become destroyed, the oil would be contained in this well formed by the floor, and so would not run about the factory. Great care should be taken to insist that inflammable liquids should be kept in this store and nowhere else. Such a store should, of course, be well ventilated and no artificial lighting of any kind be allowed in or near it. Where a quantity of scrap film or other inflammable material is likely to accumulate a proper store is essential, and Fig. 7 illustrates such a building built of asbestos slab, with a provision made for the air to pass in all round the bottom and out through the ventilator at the top, to prevent as far as possible overheating and spontaneous combustion. The roof of this building is also just laid on loosely so that in the event of a fire, and a sudden expansion of gases, the roof would come off without causing an explosion.

TURNING TO THE INTERNAL FIRE PREVENTION: smoking is perhaps the first thing to deal with. Hard and fast rules should be laid down that smoking is prohibited and suitable notices should be prominently exhibited throughout the works. Any one found breaking the rule should be severely dealt with—careless smoking may endanger the lives of many workpeople.

Order and cleanliness go far to prevent fire, and it is most essential that every possible care should be taken to eliminate as far as possible rubbish, paper, straw, etc., from lying about the floor. It has been found possible to overcome this difficulty by means of sack bins as illustrated in Fig. 8. The bin consists of a wooden frame from which is suspended a sack; the bin can be large or small and can contain one sack or several according to the quantity of rubbish likely to be accumulated. Instead of the rubbish, etc., being thrown on the floor it is placed in these sacks, and the sacks when full can be easily lifted out and others suspended. It has been found possible by this means to practically entirely do away with any rubbish scattered about. Where film or other inflammable material has to be dealt with, the same method can be adopted, but the sacks must be suspended in a metal bin. Fig. 9 illustrates such a bin in which three sacks are suspended. To place the rubbish in, a sloping lid at the top is raised. To remove the sacks when filled, the front is pulled down and the sack easily removed. Where machinery is employed a quantity of oily rags, etc., must of necessity be in use. These are always liable to spontaneous combustion if left lying about. To overcome this difficulty a small metal box about 12 in. × 12 in. × 9 in., with a spring self-closing lid as illustrated in Fig. 10, should be provided for every machine, and all oily rags, etc., kept in this and

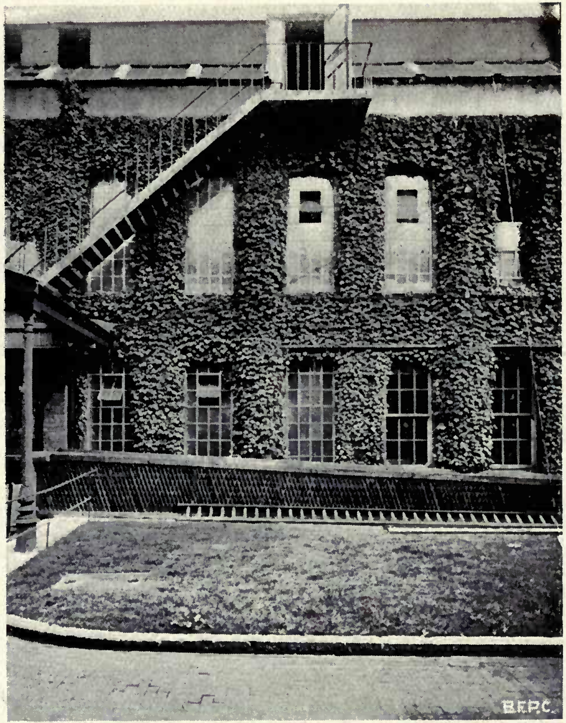

Fig. 1. Outside Fire Exit passing windows properly protected by means of steel casements and wired fire-resisting glass.

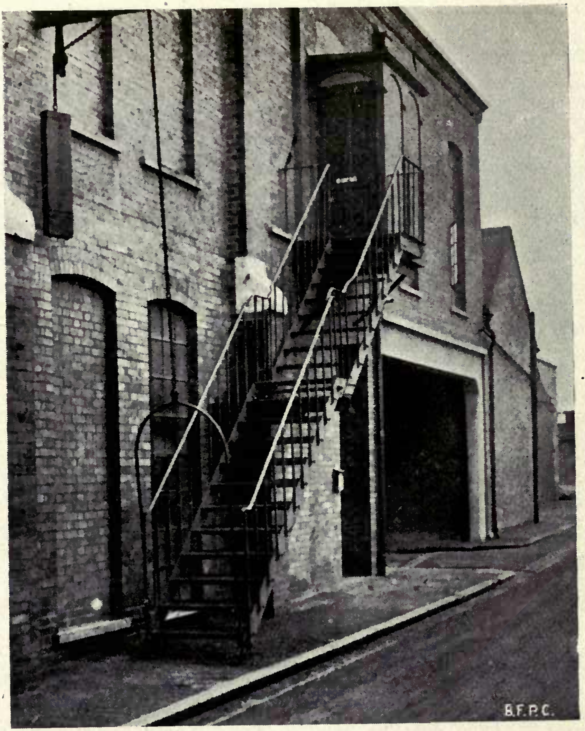

Fig. 2. Outside Fire Exit, lower half hinged to push up clear of the pathway.

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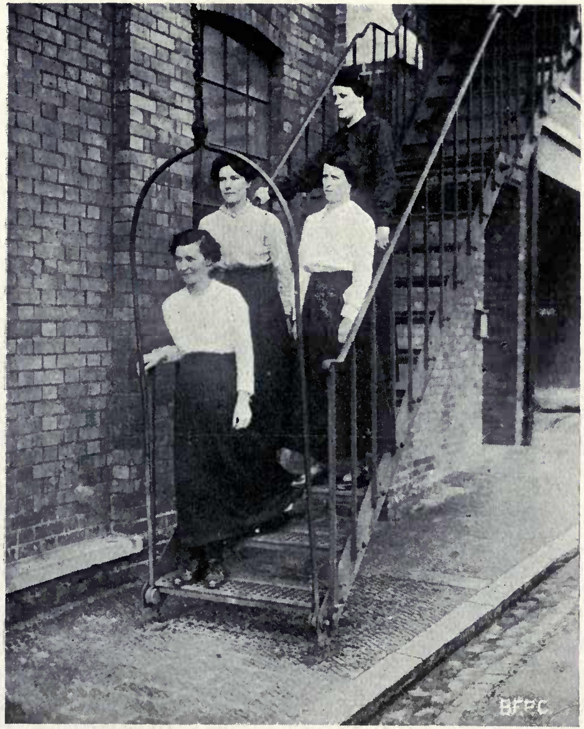

Fig. 3. THE INCORRECT METHOD FOR EMPLOYEES TO LEAVE A BUILDING.

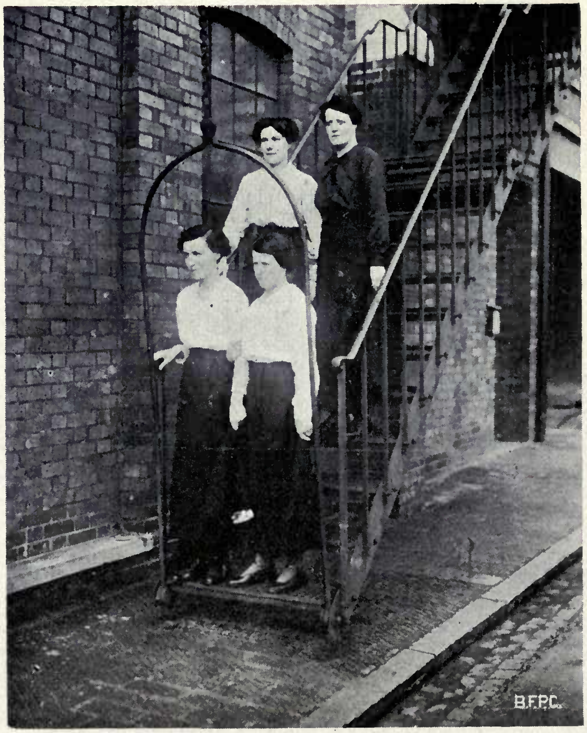

Fig. 4. THE CORRECT METHOD FOR EMPLOYEES TO LEAVE A BUILDING, TWO BY TWO, AND HOLDING SKIRT WITH ONE HAND AND RAIL OR GIRL NEXT HER WITH THE OTHER FOR SUPPORT.

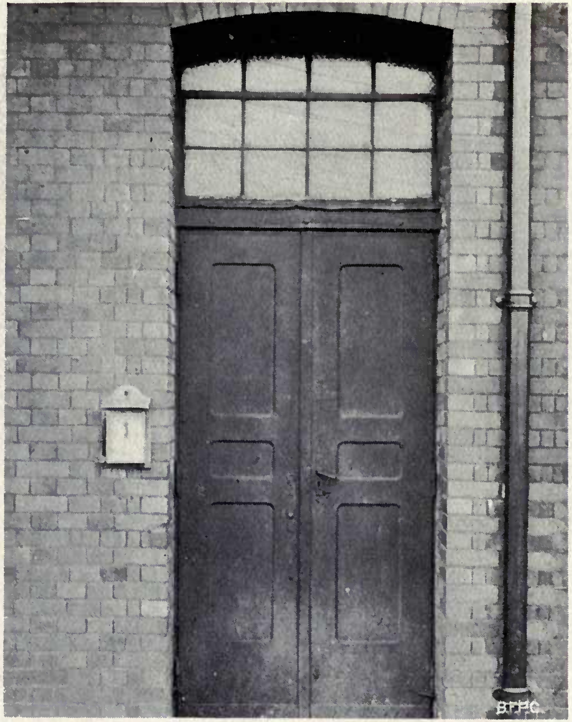

Fig. 5. KEY IN BOX, OUTSIDE FIRE EXIT TO WHICH IRON DOORS ARE FIXED, SO THAT INSTANT ACCESS CAN BE GAINED IF REQUIRED.

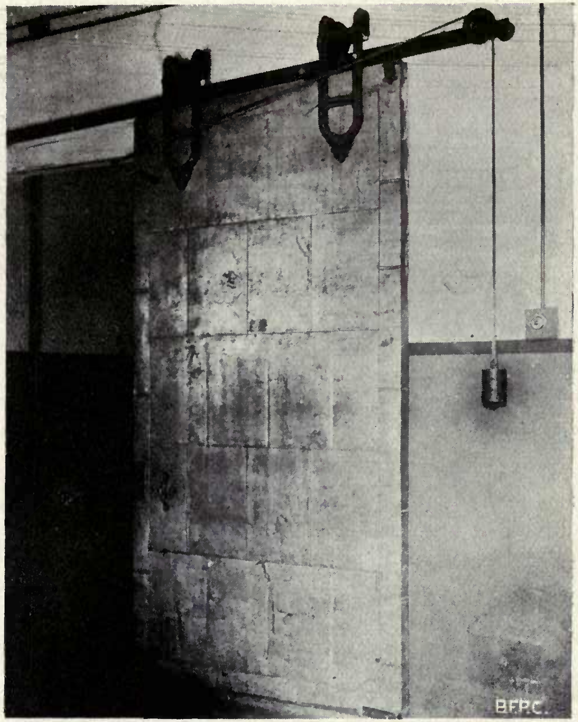

Fig. 6. SLIDING METAL-COVERED FIRE-RESISTING DOOR.

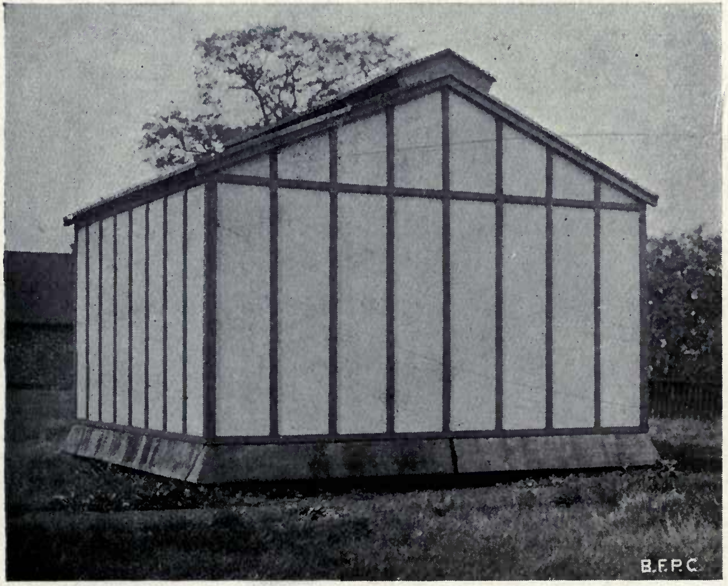

Fig. 7. BUILDING OF ASBESTOS SLAB FOR COMBUSTIBLE MATERIAL WITH VENTILATORS TO ENABLE AIR TO ENTER AT BOTTOM AND PASS OUT THROUGH TOP, AND THUS KEEP CONTENTS COOL TO PREVENT SPONTANEOUS COMBUSTION.

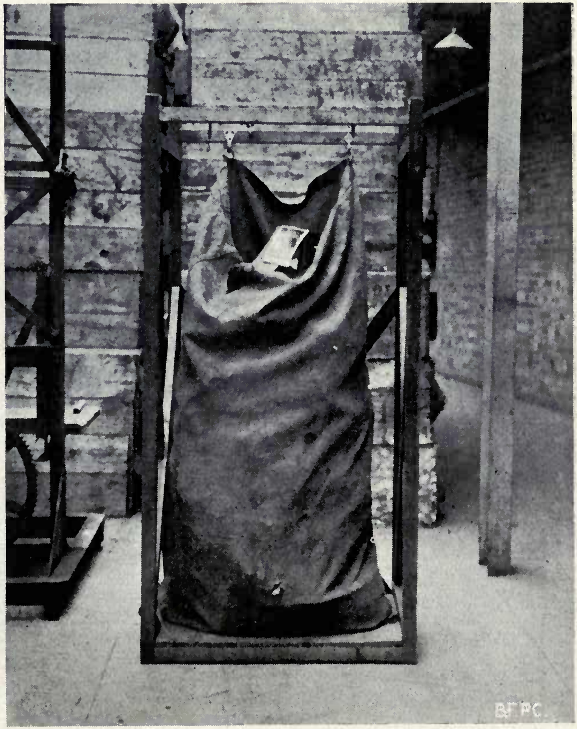

Fig 8. SACK SUSPENDED IN WOOD FRAME IN WHICH TO PUT RUBBISH, PAPER, STRAW, ETC.

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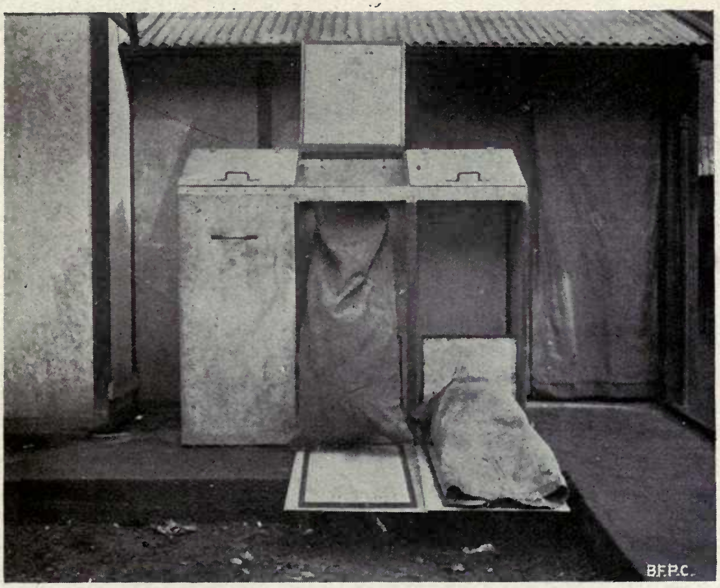

Fig. 9. METAL BIN IN WHICH TO SUSPEND SACKS TO TAKE FILM SCRAP OR OTHER INFLAMMABLE REFUSE.

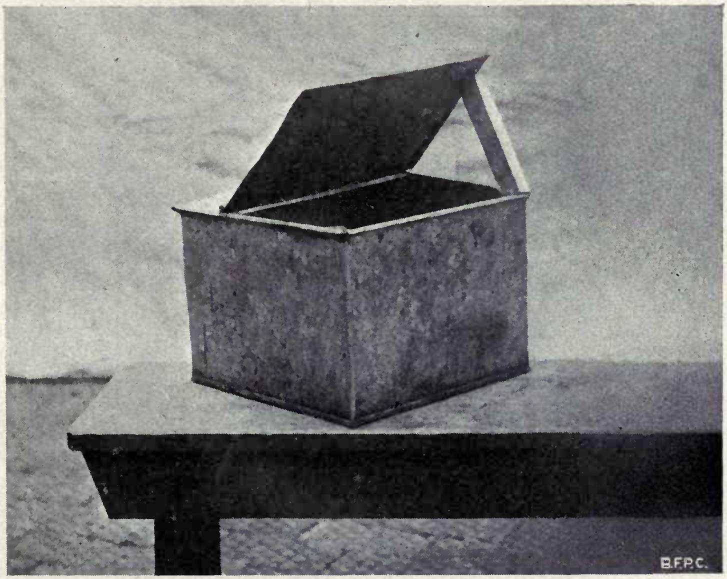

Fig. 10. METAL BOX WITH SPRING LID IN WHICH TO KEEP OILY RAGS, ETC.; ONE SHOULD BE PROVIDED TO EACH MACHINE.

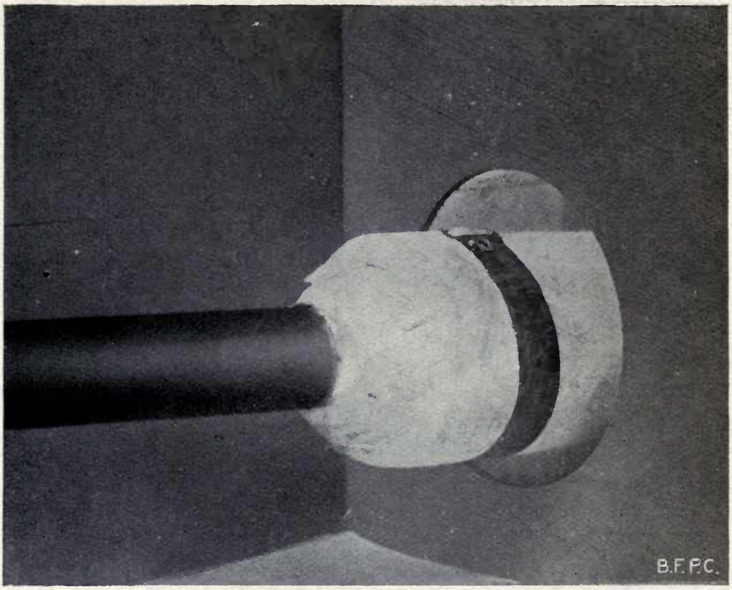

Fig. 11. PROPER PROTECTION FOR STEAM PIPES WHEN PASSING THROUGH OR NEAR WOOD PARTITIONS, ETC.

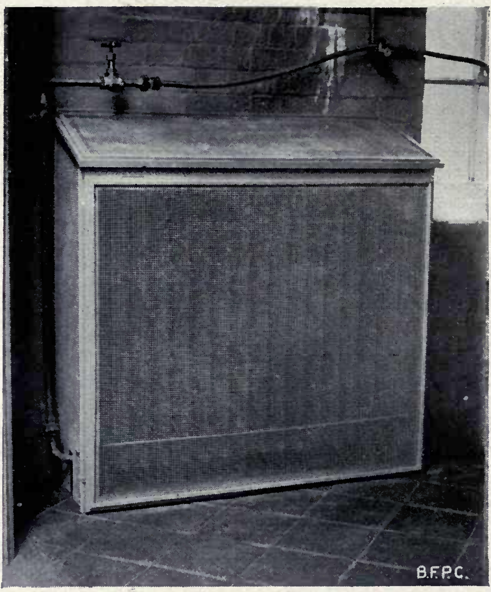

Fig. 12. RADIATOR PROTECTED TO PREVENT RUBBISH, ETC., COLLECTING ON AND GETTING INTO CONTACT WITH THE HOT PIPES.

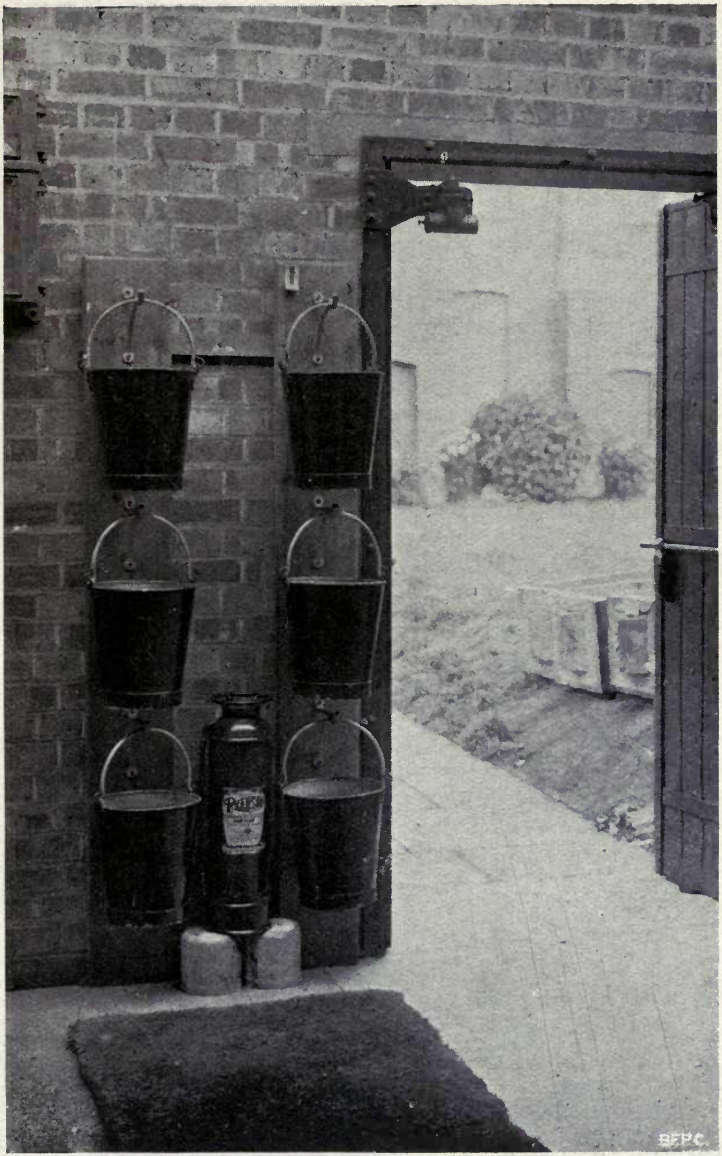

Fig. 13. Internal Fire Pail Station with Extinguisher. Note position just inside door.

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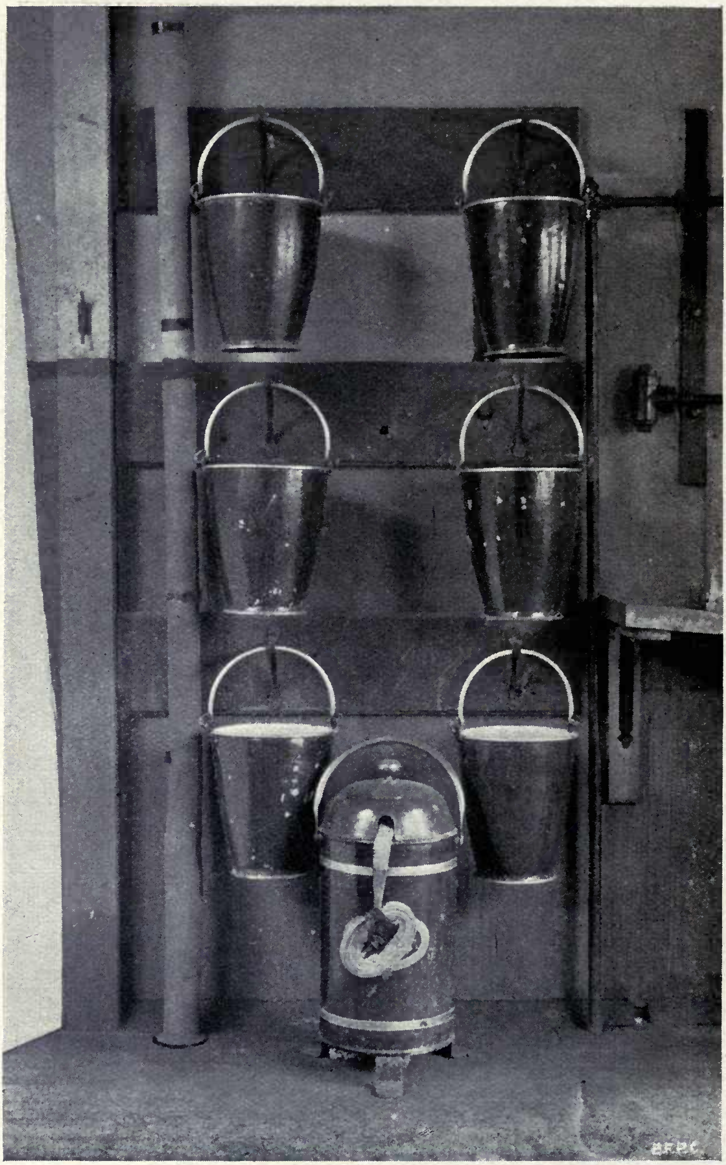

Fig. 14. INTERNAL FIRE PAIL STATION AND HAND PUMP.

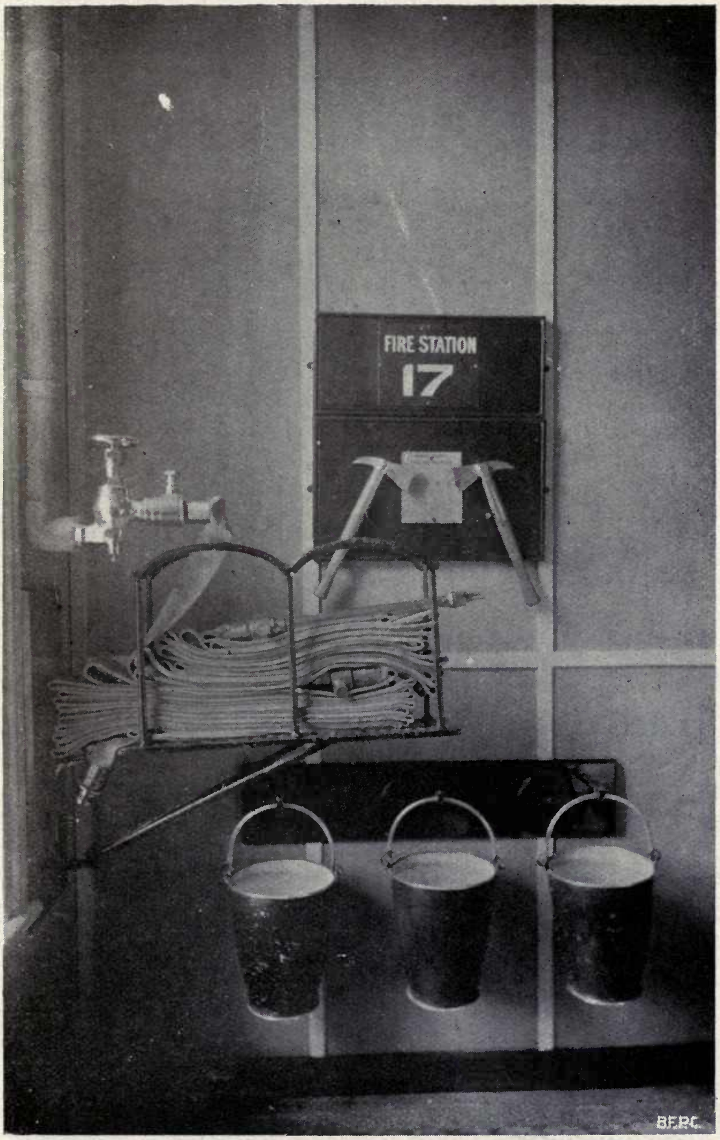

Fig. 15. INTERNAL HYDRANT AND PAIL STATION FITTED WITH 1¾″ HOSE AND ⅜″ NOZZLE TO REDUCE WATER DAMAGE.

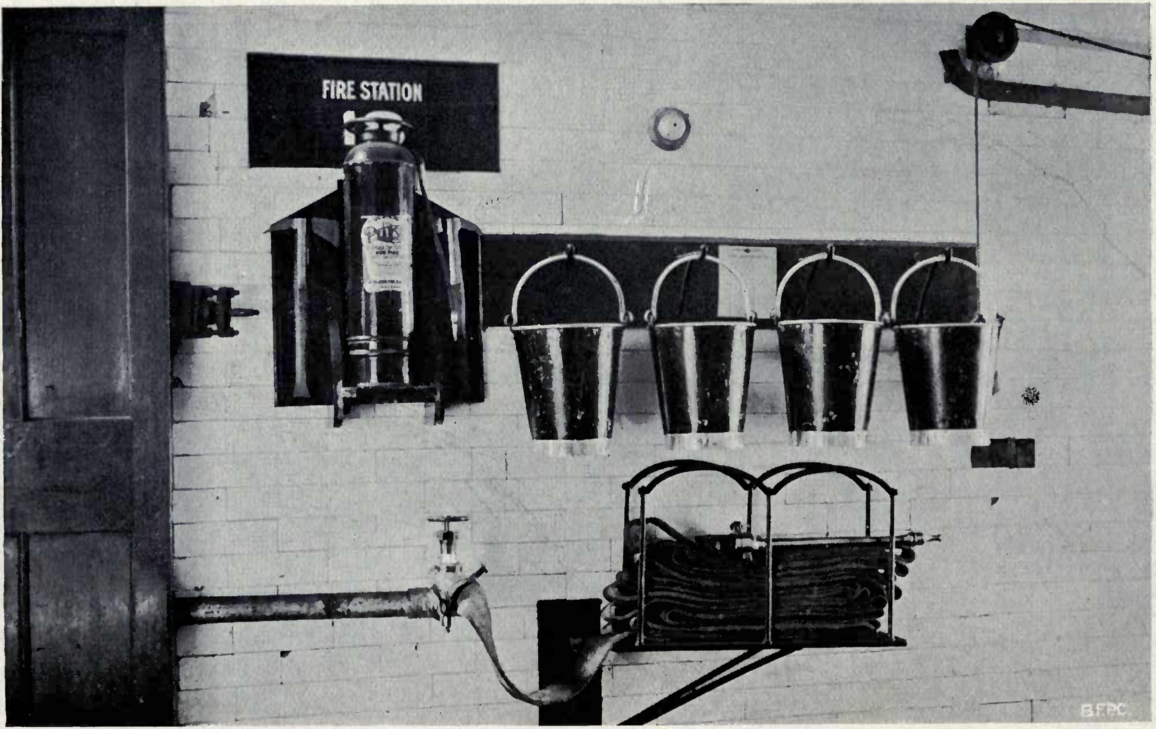

Fig. 16. Internal Hydrant, Fire Pail and Extinguisher Station, 1¾″ instantaneous couplings on hose.

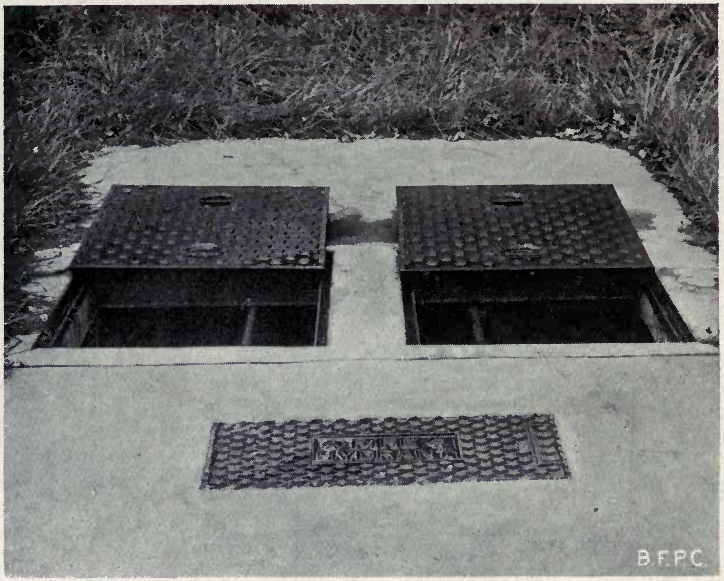

Fig. 17. Underground Tank provided with two Baffle Plates to remove aeration from water when testing motor pump.

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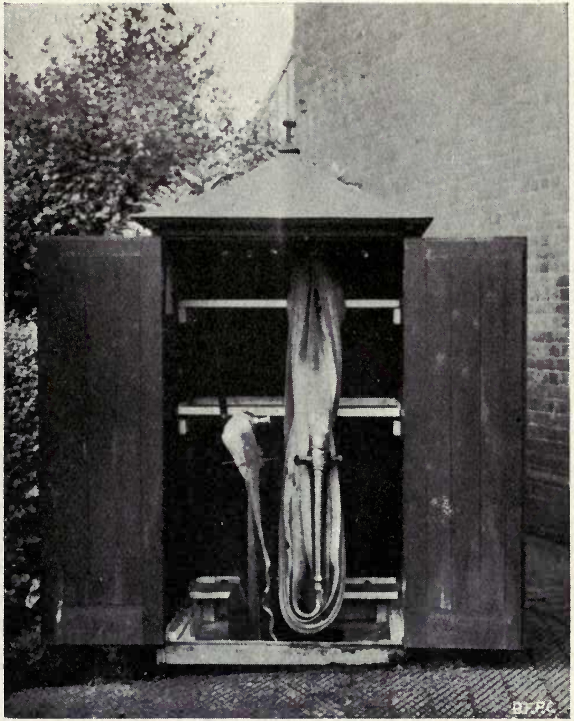

Fig. 18. Outside Hydrant with hose attached to standpipe and flaked NOT recommended.

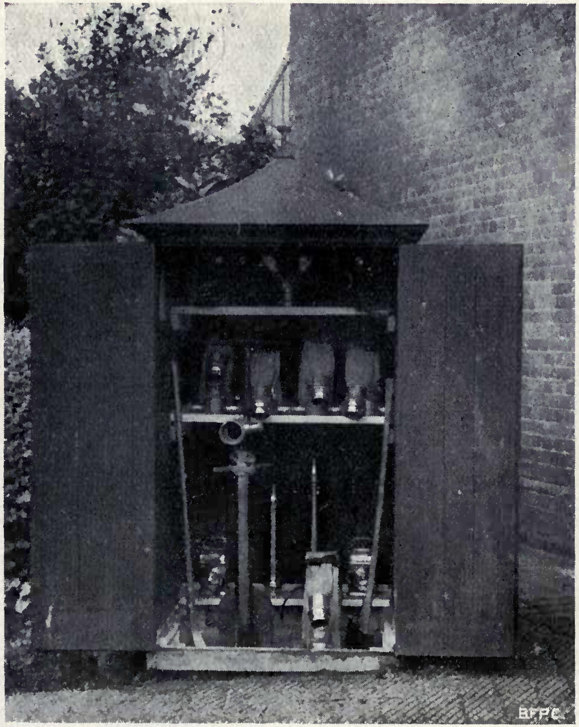

Fig. 19. IF HOSE MUST BE KEPT IN OUTSIDE HYDRANT BOX, THIS METHOD IS RECOMMENDED.

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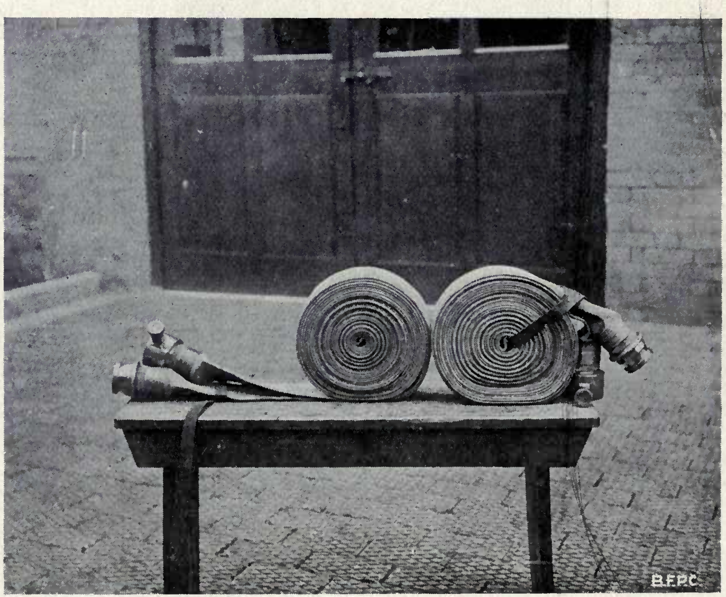

Fig. 20. HOSE ROLLED ON THE BIGHT OR FROM THE MIDDLE.

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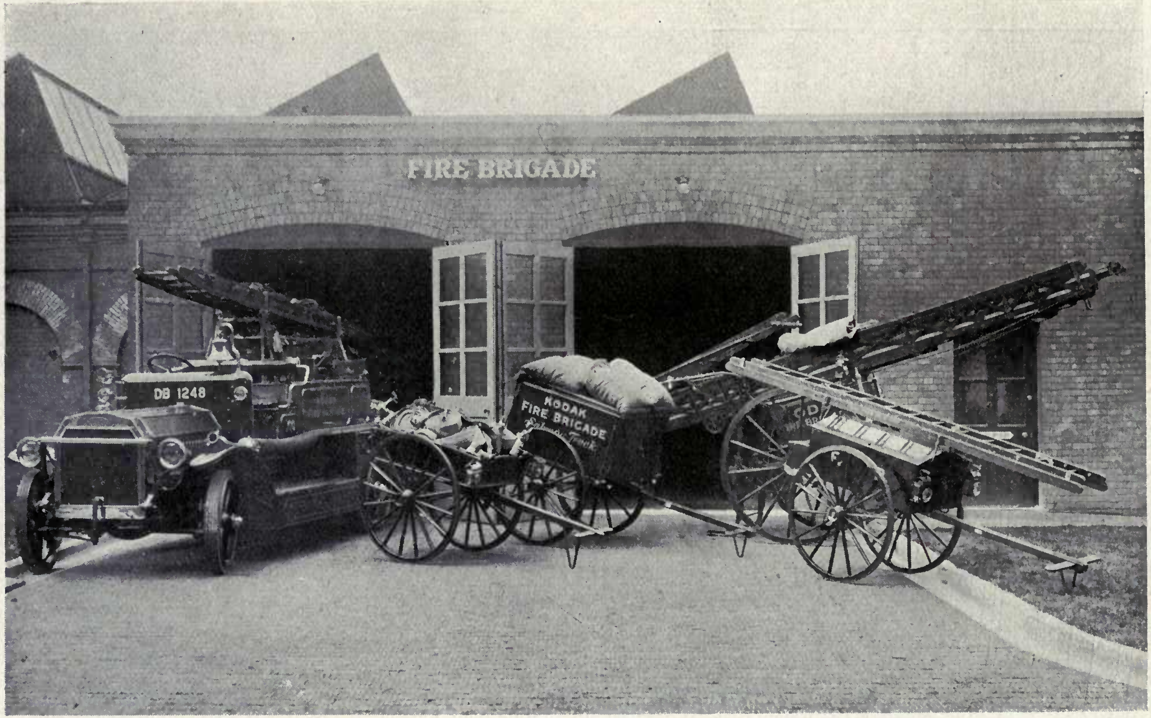

Fig. 21. WORKS FIRE STATION WITH APPLIANCES, INCLUDING 45 H.P. DENNIS MOTOR PUMP, 50 FT. ESCAPE, TWO HOSE CARTS AND SALVAGE TRUCK.

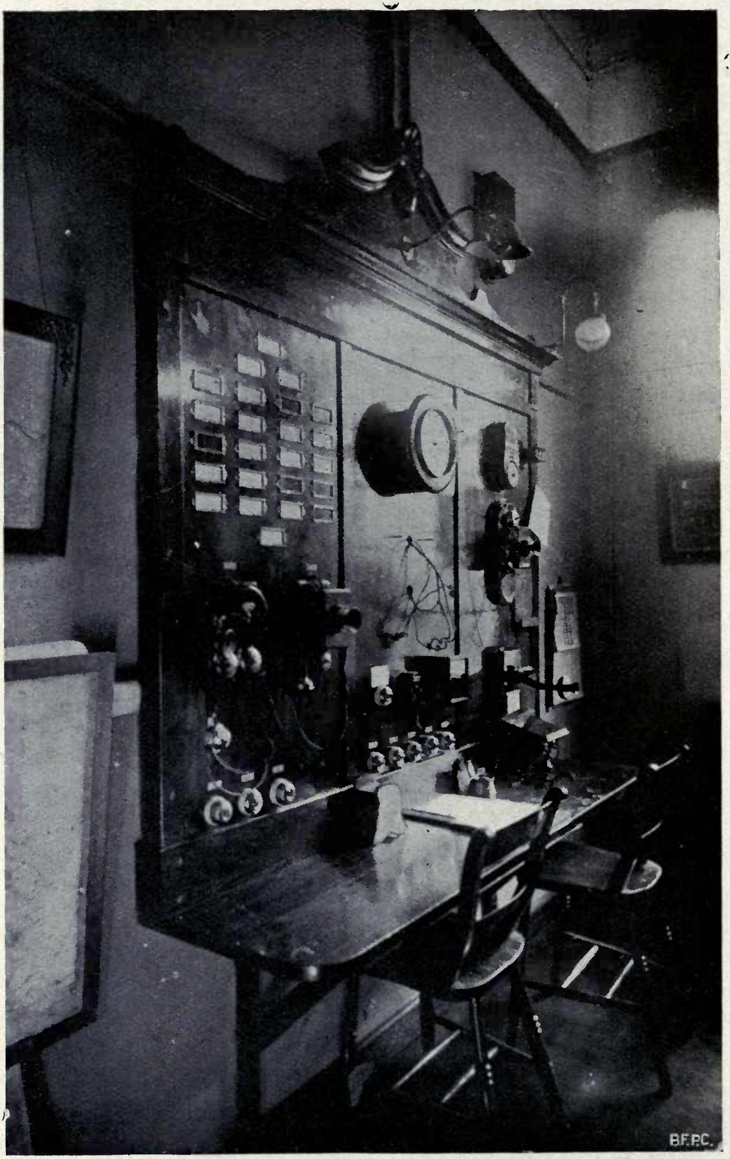

Fig. 22. WATCH ROOM, WITH TELEPHONES, ETC. THE WORKS TELEPHONE EXCHANGE IS ALSO SITUATED HERE. TWO MEN ARE ALWAYS ON DUTY.

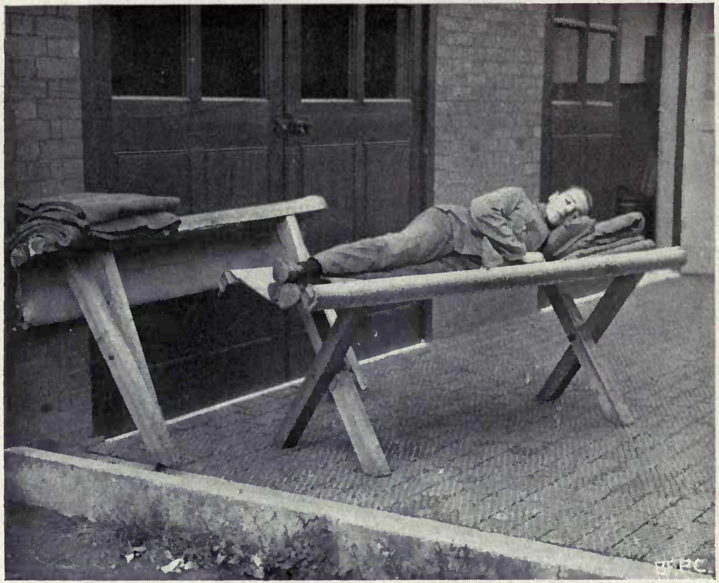

Fig. 23. TRESTLES FOR THE MEN TO SLEEP ON, OPEN AND CLOSED.

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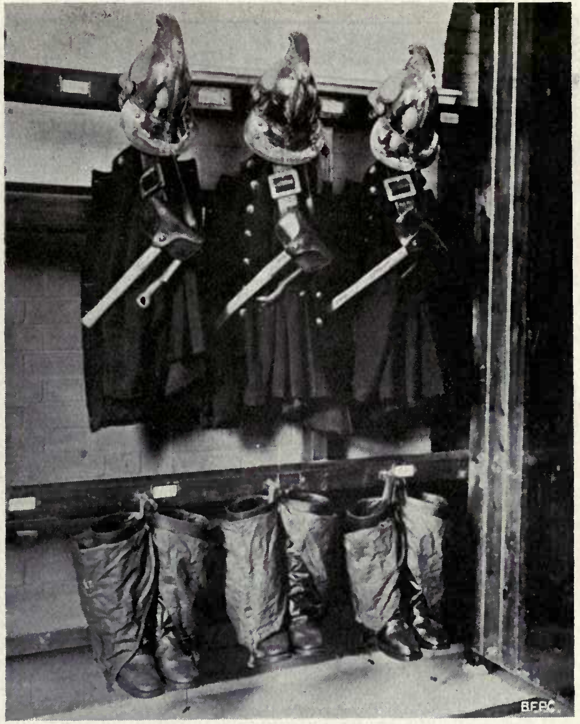

Fig. 24. METHOD OF HANGING UNIFORMS. NOTE WATERPROOF OVERALL LEGGINGS ON BOOTS.

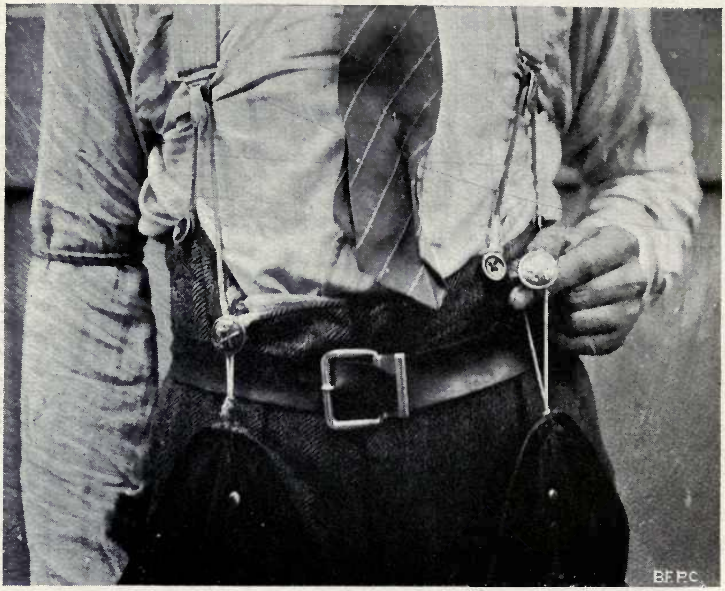

Fig. 25. METHOD OF SUSPENDING OVERALL LEGGINGS. A LOOP WITH BUTTON ON END IS PASSED ROUND BRACES AND BUTTON PUT THROUGH LOOP.

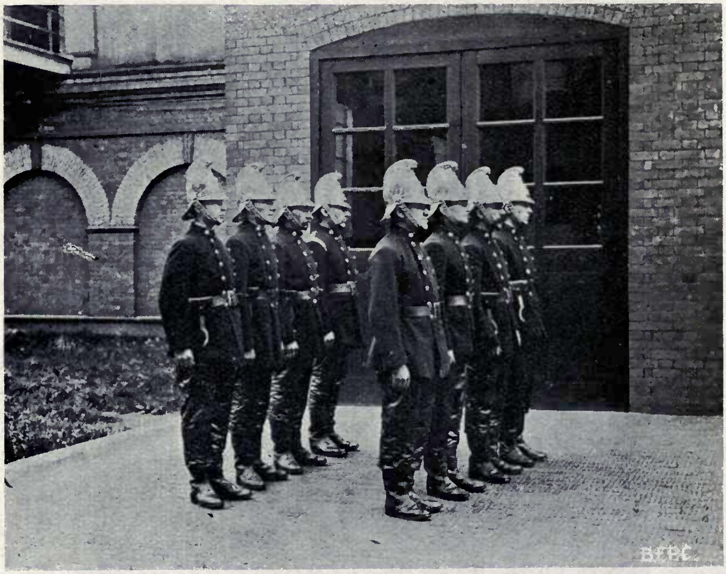

Fig. 26. BRIGADE IN FIRE KIT WITH WATERPROOF OVERALL LEGGINGS AND ORDINARY TROUSERS.

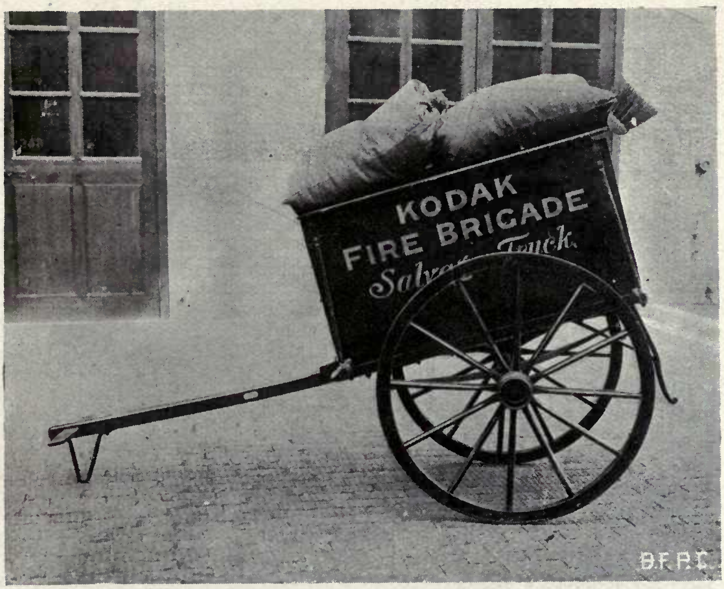

Fig. 28. SALVAGE CART, A MOST USEFUL APPLIANCE.

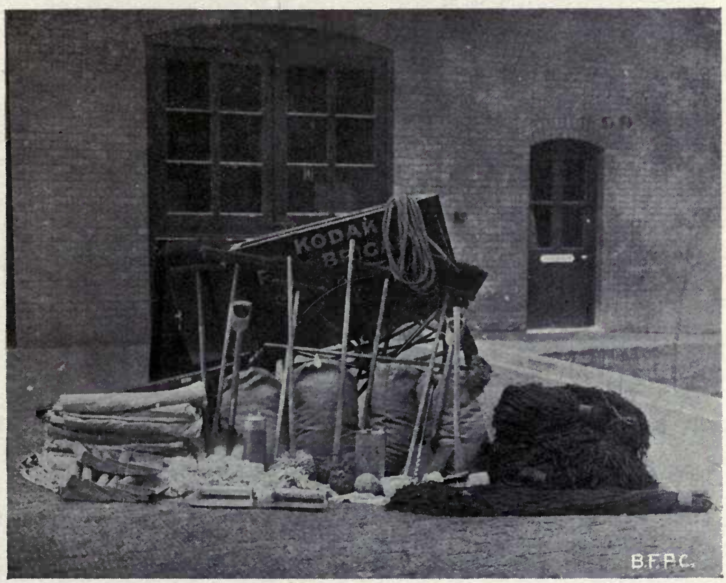

Fig. 29. CONTENTS OF SALVAGE CART, WHITE WATERPROOF SHEETS, SWABS, BROOMS, SQUEEGEES, SCOOPS, ETC., ETC.

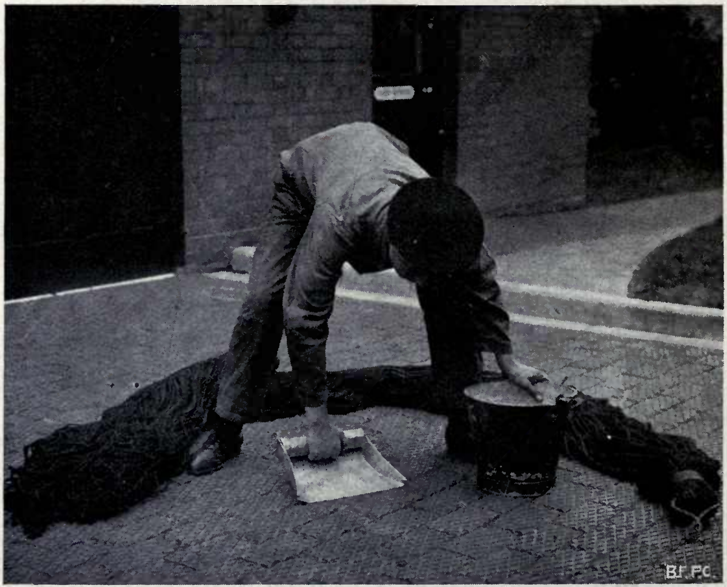

Fig. 30. METHOD OF USING SCOOPS IN CLEARING UP WATER. THE SWABS FORM A DAM INTO WHICH THE WATER IS SWEPT.

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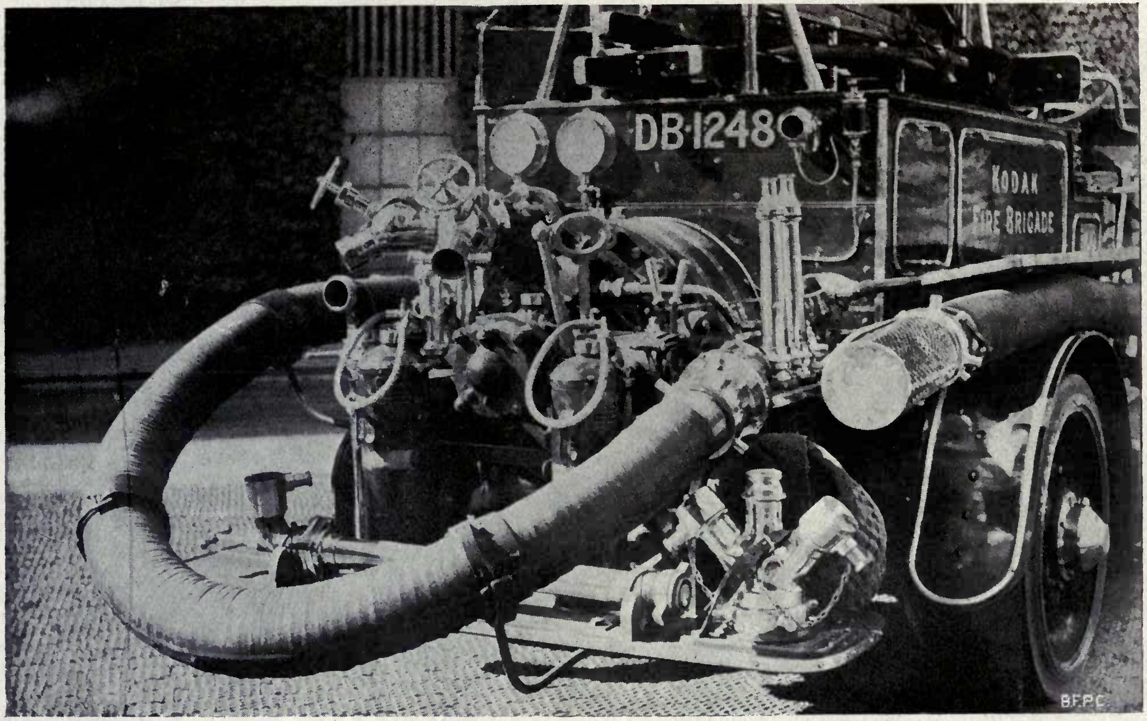

Fig. 31. Rear view of Dennis 45 h.p. Turbine Motor Pump giving a view of the suction direct coupled and position in which the gear is carried.

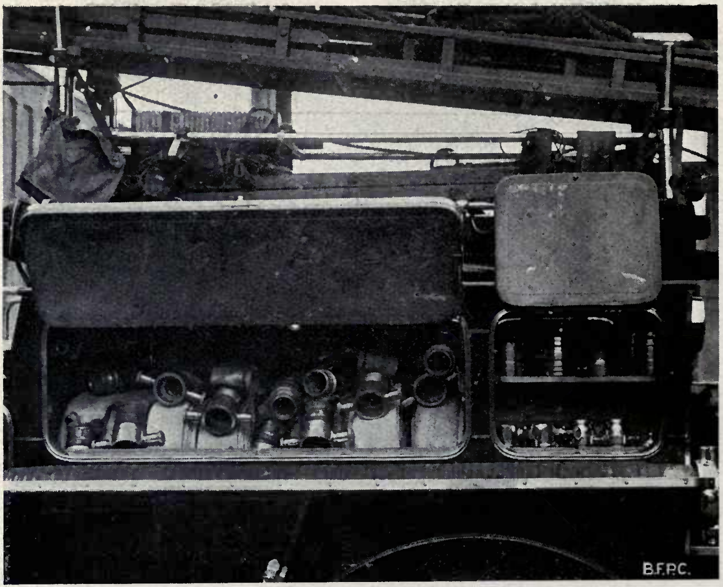

Fig. 32. NEAR SIDE VIEW OF MOTOR PUMP, WHICH SHOWS METHOD OF STOWING HOSE AND ELECTRIC LIGHT IN HOSE BOX, ALSO VARIOUS ADAPTORS EACH CARRIED ON A SEPARATE PIN.

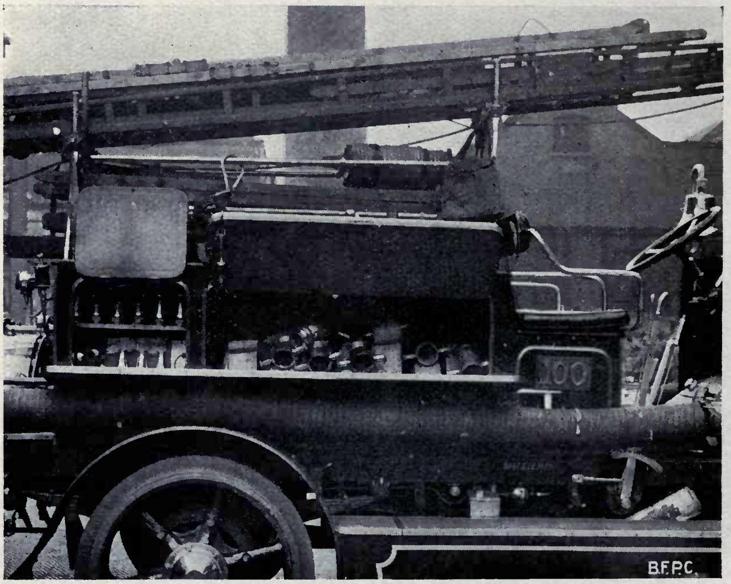

Fig. 33. OFF SIDE VIEW OF MOTOR PUMP, SHOWING NOZZLES, EACH CARRIED ON SEPARATE PINS.

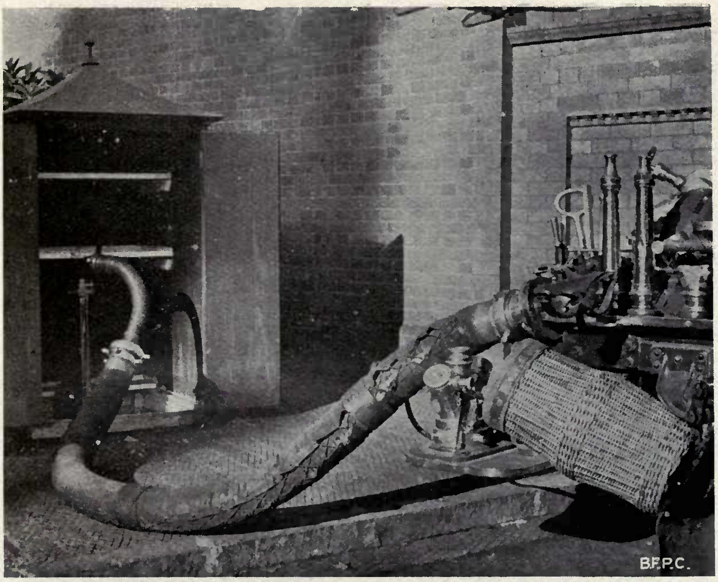

Fig. 34. METHOD OF CONNECTING DIRECT TO STANDPIPE WITH DIRECT SUCTION ADAPTOR.

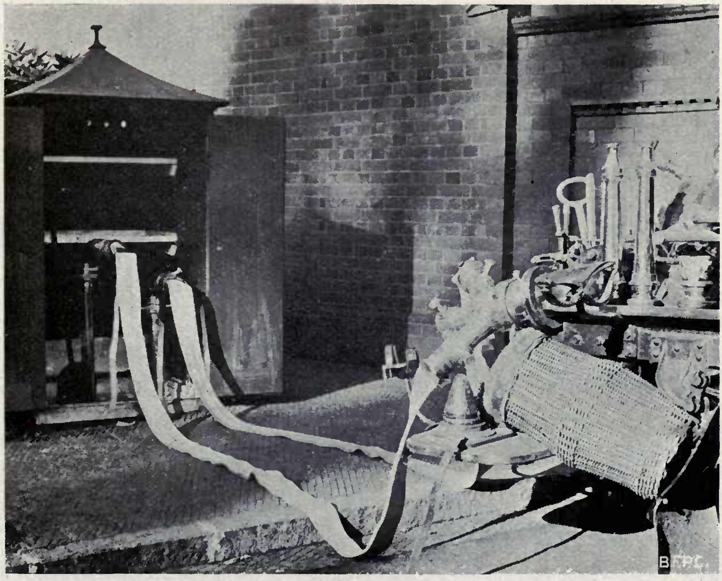

Fig. 35. METHOD OF GETTING TO WORK FROM TWO OR MORE HYDRANTS BY MEANS OF HOSE AND COLLECTING HEAD.

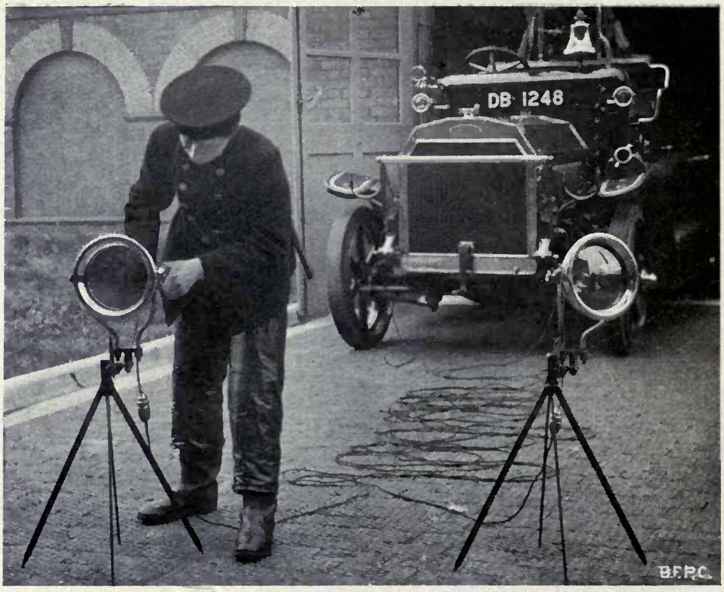

Fig. 36. HEAD LIGHTS ON STAND TO BE USED AS SEARCHLIGHTS.

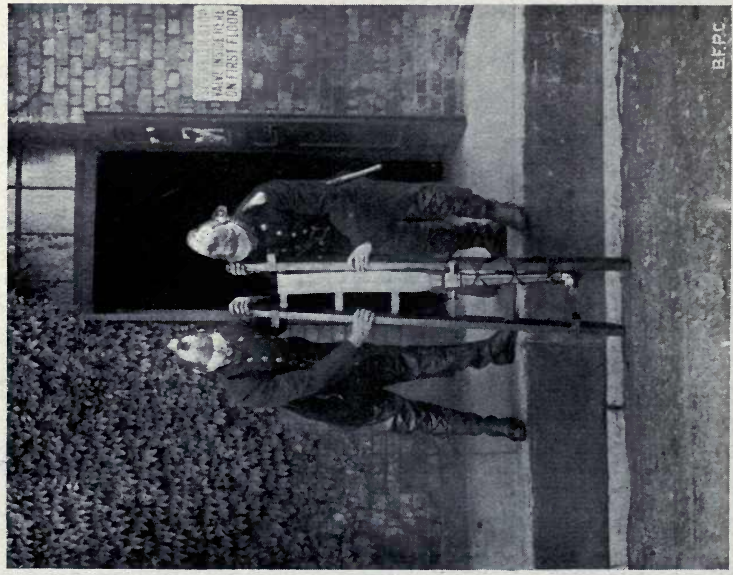

Fig. 37. IMPROVISED CELLAR PIPE, BRANCH WITH ELBOW LASHED TO SCALING LADDER.

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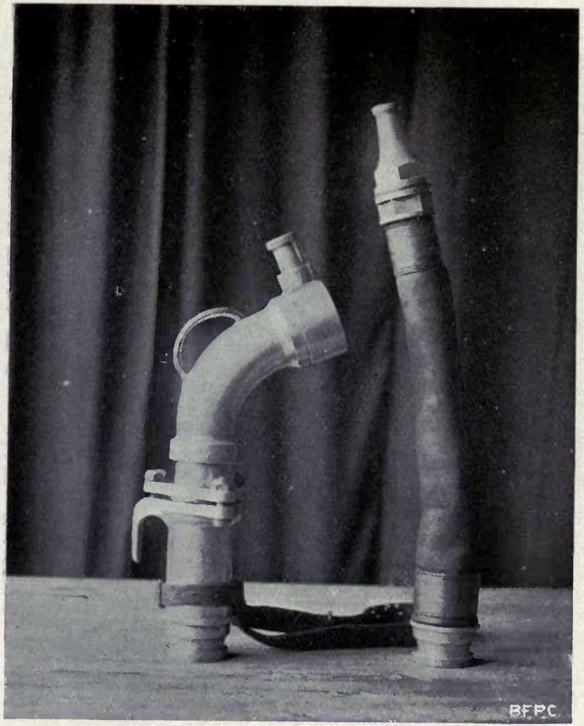

Fig. 38. HOSE SUSPENSION ELBOW WITH HOOK TO HANG ON RUNG OF LADDER, ALSO FLEXIBLE LEATHER BRANCH FOR USE WITH SAME.

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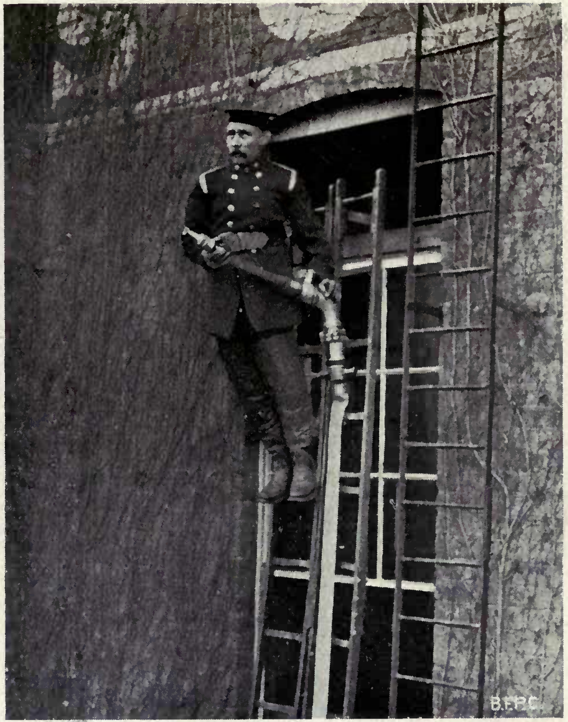

Fig. 39. HOSE SUSPENSION ELBOW IN USE ON HOOK LADDER. IT CAN BE USED ON ANY LADDER OR ESCAPE WITHOUT PREVIOUS FITTING.

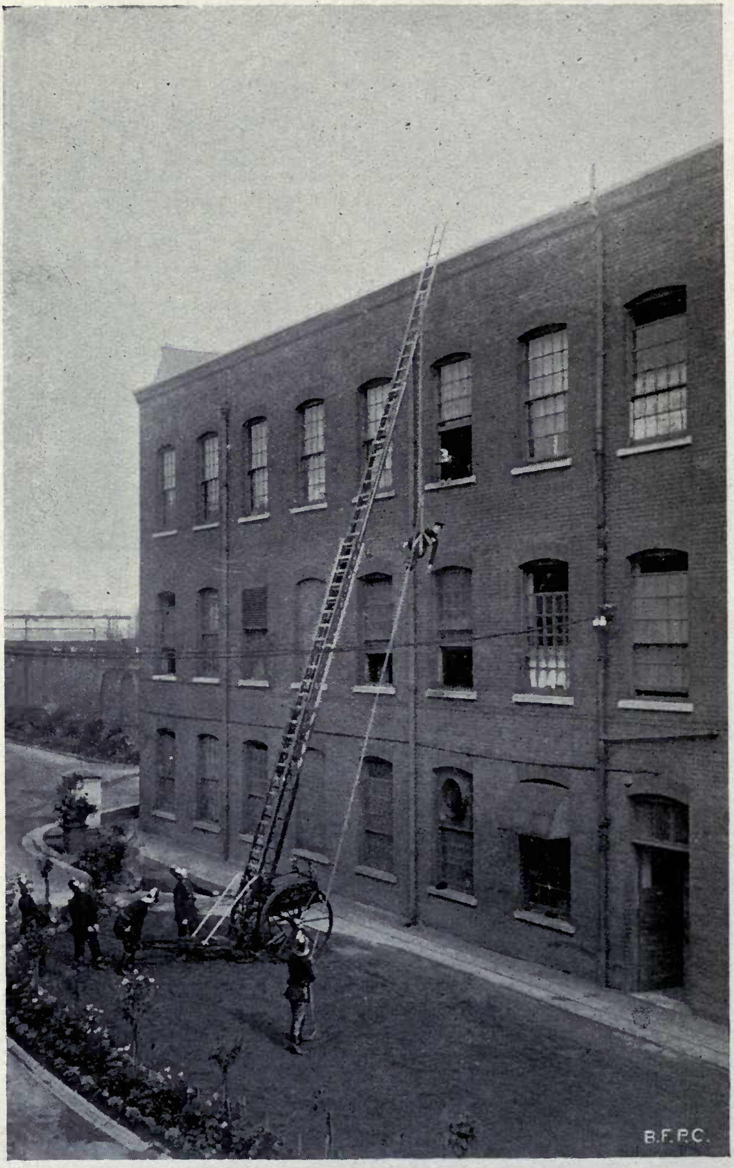

Fig. 40. METHOD OF LIFE SAVING BY MEANS OF LIFE LINES PASSED OVER RUNG OF ESCAPE AND CONTROLLED BY MEN ON THE GROUND.

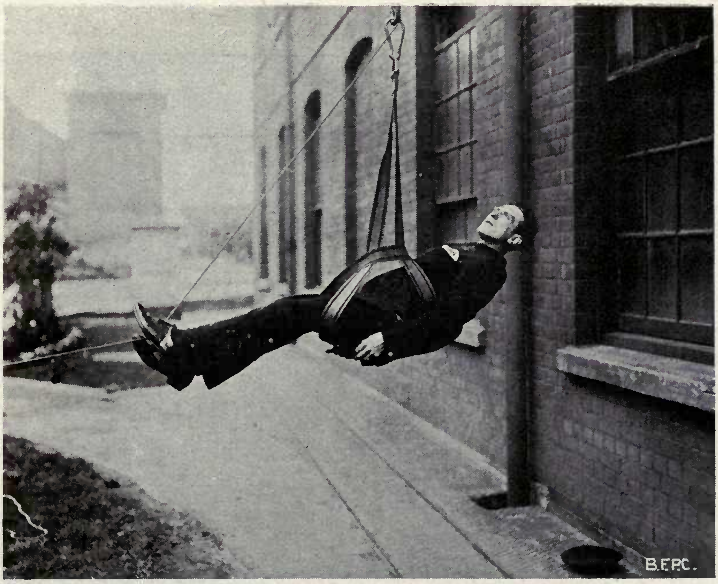

Fig. 41. SLING USED IN PLACE OF CHAIR-KNOT, SHOWING SPRING HOOK TO ATTACH TO ROPE, ALSO GUY LINE.

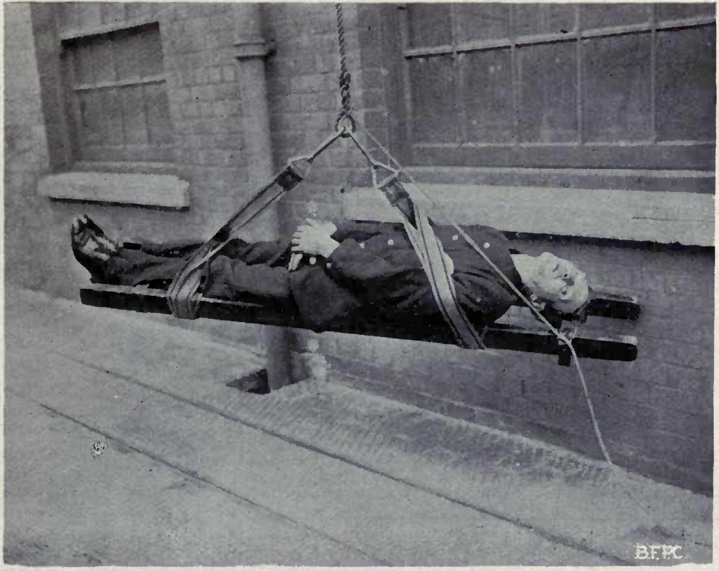

Fig. 43. METHOD OF REMOVING INJURED OR BED-RIDDEN PERSON WITH TWO SLINGS AND SCALING LADDER.

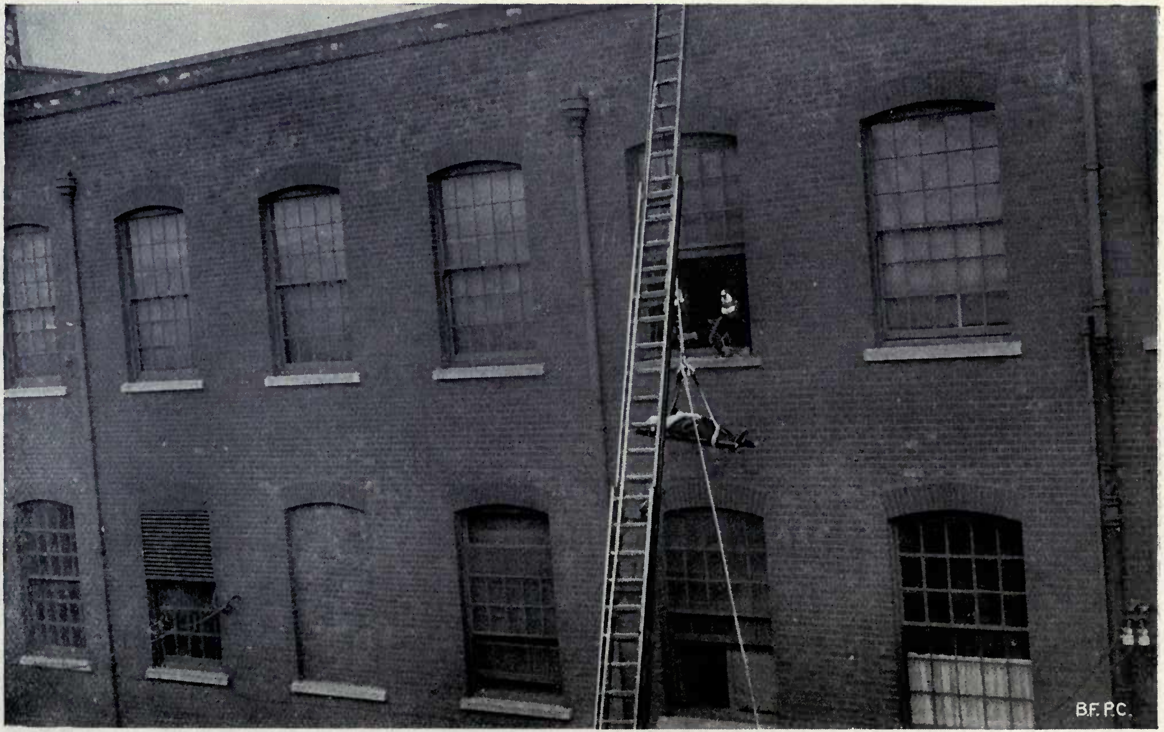

Fig. 42. METHOD OF RESCUING A PERSON INJURED, ILL, OR BED-RIDDEN BY MEANS OF LINE PASSED OVER RUNG OF ESCAPE, A SCALING LADDER BEING USED AS STRETCHER AND SUSPENDED BY TWO SLINGS TO END OF LIFE LINE.

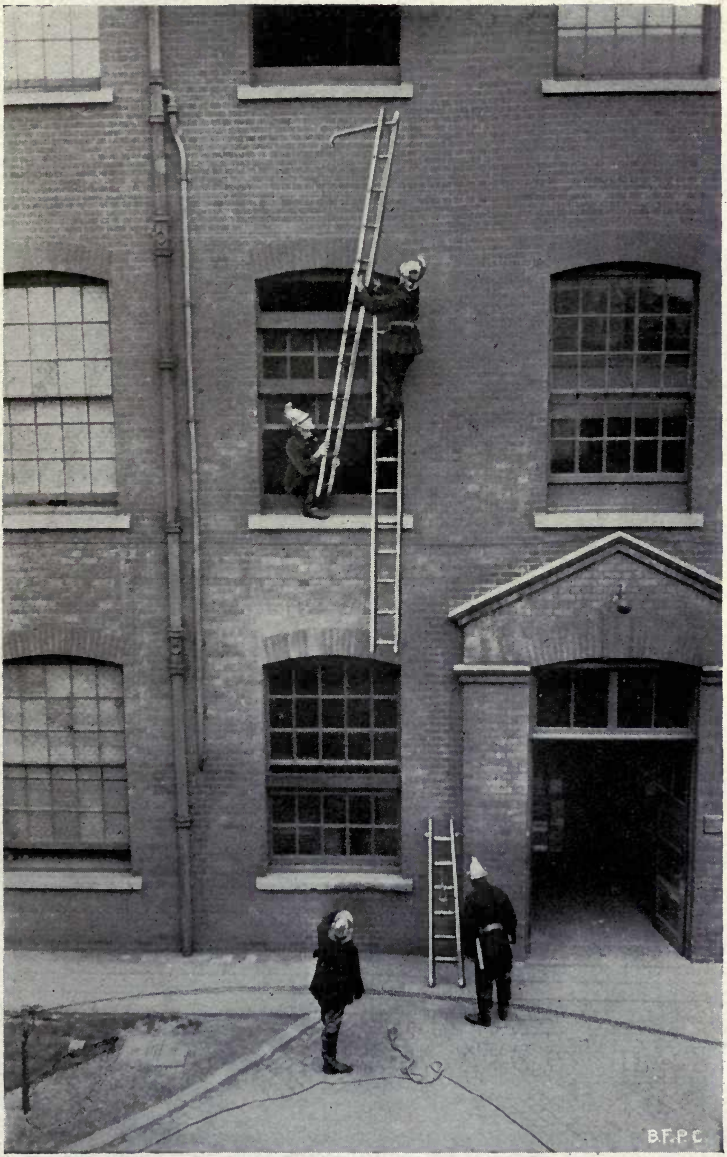

Fig. 44. METHOD OF SCALING BUILDING BY MEANS OF ONE OR TWO HOOK LADDERS.

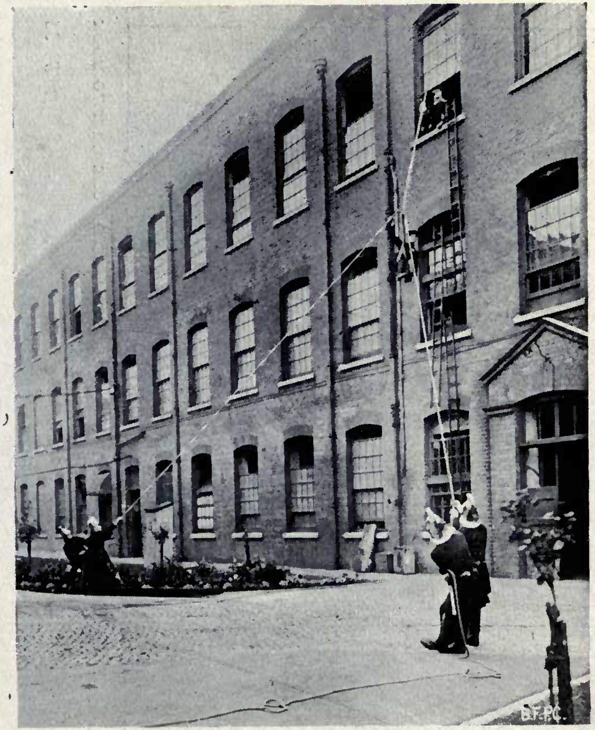

Fig. 45. METHOD OF RESCUE BY MEANS OF DOUBLE LINE AND SLING.

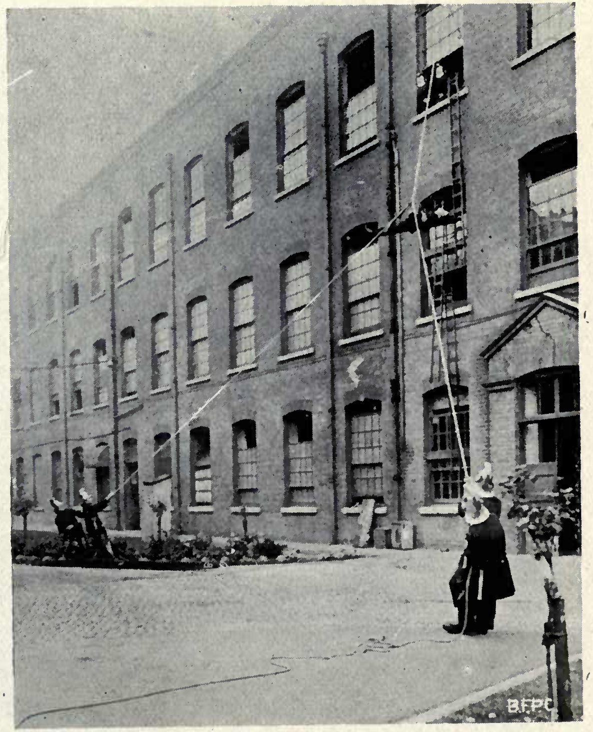

Fig. 46. METHOD OF RESCUING INFIRM OR INJURED PERSON BY MEANS OF SLINGS, SCALING LADDER AND DOUBLE LINES.

nowhere else. This should be emptied regularly each night.

Employees should not be allowed to have meals in their departments, the greasy paper in which food has been wrapped being especially liable to spontaneous combustion if in contact with hot water pipes.

The heating apparatus of buildings requires careful attention, especially if steam is used for this purpose. To keep heating pipes and radiators clear from rubbish is absolutely essential. Where steam pipes pass through or near wood partitions it is not sufficient to simply leave an air space all round, but better far to cover the pipes with magnesia covering as illustrated in Fig. 11, and thus make quite sure that the protection is sufficient. Radiators and pipes where steam only is used should be protected to prevent paper, rubbish, etc., from collecting and getting into contact with the hot pipes. Fig. 12 illustrates a good protection for this purpose, made of small-mesh wire, the top being made to slope to prevent it being used as a shelf, and the lower part hinged to allow for cleaning. In removing hot ashes from the furnaces, etc., care should be taken not to stack them up against the wall of a building, otherwise the heat may be conveyed through the brickwork and a fire started within.

Wherever possible the lighting should be by electricity, and the wiring carried throughout in screwed metal tubing. No person other than competent electricians should be allowed to instal this, insert new fuses or run additional wiring; it is tampering with the installation by inexperienced people which causes fires. All spaces under switches, distribution boards or near electric motors, etc., must be kept free from waste paper or other inflammable material. Where electric irons, glue pots, etc., are used, a pilot light should be fixed which lights up when in use: this draws attention at once if the current is left on by mistake. Under no circumstances should candles, paraffin lamps or anything of that kind be used as a temporary light; proper electric lamps should be kept for this purpose, and for the use of night watchmen.

When gas is the only illuminating agent obtainable, proper protection from the heat given off is necessary when near or under woodwork, and the use of Asbestos Slab is desirable; fixed gas brackets which cannot swing round against the wall only should be used. The greatest objection to gas is the necessity of striking matches to light same and the glowing match carelessly thrown down. Bypass incandescent gas burners get over the difficulty, as when once lit they can be turned up or down as required. The lighting of all gas jets should be the work of certain people told off for that purpose and they should be responsible and see that proper care is taken.

Fire Protection.

The provision of First Aid fire appliances is one which requires careful consideration. It is impossible to definitely lay down any lines as to the exact procedure which should be adopted owing to the variation in the work carried on in different buildings, but it is an excellent plan, instead of having the fire pails scattered about singly where perhaps one could be found and after being used it would be necessary to look round to find another, to have a regular station of say four or six pails with a chemical fire extinguisher, in one place. It has been found that the best place for these is immediately inside the door of each department. This is, as far as possible, standardized throughout the factory, the idea being that the watchman in going his rounds, if he discovers a fire, has the pails to hand on entering the department. Such a Fire Pail Station is illustrated in Fig. 13, which also shows the outside exit doors provided with panic bolts. Fig. 14 illustrates another station provided with a hand pump instead of extinguisher. In providing internal fire hydrants it has been found that generally speaking it is not advisable for these to be the ordinary 2½ in. owing to the enormous water damage which may be caused in dealing with small fires. Fig. 15 illustrates the method which has been adopted, 1¾ in. hose being used with a ⅜ in. nozzle. In dealing with small fires the water damage is therefore very much limited, and should it be necessary for a larger supply of water to be used, outside fire hydrants can be speedily got to work. All internal fire hydrants are numbered and each one is a substantial First Aid Station of itself.

Fig. 16 illustrates such station provided with a hydrant and pails, also an extinguisher.

The hose is kept flaked in a cradle so that it can be speedily got to work.

In a large works the difficulty of knowing exactly where the fire mains are situated, where fire hydrants are to be found, where fire doors and party walls are situated, can be got over by means of providing a complete plan of each floor. On this should be marked clearly the position of every hydrant, both internal and external, fire mains, fire pails, extinguishers, hand pumps, fire doors, etc., so that the officer responsible only has to glance at this plan suspended in his office and he can tell instantly the fire protection of each department. The provision of an adequate supply of outside fire hydrants round the buildings is important, care being taken that the mains are large enough to provide an ample supply of water should several hydrants be open at the same time. It is also advisable to subdivide the installation into sections by means of valves, so that in the event of a burst in one section, the remainder can be used without it being necessary to shut off the whole supply. An inexhaustible and efficient water supply to the hydrants is absolutely essential, and by means of a little organization several sources of supply can be arranged. The works' reservoir of say 50,000 gallons supplied from the factory wells can be supplemented by having the public water supply laid on and controlled by a fullway valve to be opened only in case of fire. This ensures an almost certain supply to the reservoirs ; a steam pump of a capacity of 650 galls. per minute pumping from the reservoir to mains supplying the hydrants is most efficient, the pressure being regulated by means of a bypass. The public water supply should also be connected direct to the fire mains and controlled by means of a fullway valve which could be opened should the steam fire pump fail. A motor fire engine which can be coupled direct to any hydrants makes the protection complete.

It is useless arranging for the attendance of a number of fire engines in the event of a serious fire unless ample provision is made to provide them with sufficient water to get to work when they arrive. The provision of underground tanks to which the mains are connected by means of a fullway valve provides a place from which one or more pumps can get to work. These tanks can also be used for testing steam or motor fire engines. Fig. 17 illustrates such an underground tank which is provided with two baffle plates to remove the aeration from the water. The suction should be placed in one compartment and the water from the branch directed in the opposite compartment. The water then in passing over the baffles has a great deal of the aeration removed. It will thus be found possible to run the steamer or motor for the test purposes for an hour or more without wasting practically any water. A motor inspection pit used for inspecting motor appliances can also have the mains connected to it and be used as a tank to pump from in case of emergency. The provision of outside fire hydrant boxes in which hose is kept is most undesirable, the hose always being subject to the effects of the atmosphere becomes damp and mouldy and eventually rots, and when not under proper supervision is often useless when required. Again, generally speaking only one or two lengths are kept in each box and it would be necessary to run to several boxes to collect enough hose to deal with the fire. Such a box is indicated in Fig. 18 with the hose flaked and coupled direct to the stand pipe. This again is not recommended, as in collecting hose from several different boxes it is liable to become entangled and cause delay. It is far more efficient to have the hose kept in a hose cart, which in the event of being required can be run to the spot at once. If for some reason the system of having the hose in a hose cart is not practicable and the lesser of the two evils is necessary, namely, to keep a certain quantity of hose in outside boxes, Fig. 19 illustrates the method recommended. The hose is rolled and not direct coupled, therefore if it is needed for use at any hydrant it can be instantly picked up without having to disconnect it. The system of rolling or flaking hose is one upon which a variety of opinions exist, but there is much to be said in favour of rolling the hose on the bight, i.e. from the middle. In other words, double the hose back with the two couplings together and commence rolling from the centre as Fig. 20. For speed in getting the lines of hose to work, this is far in advance of any other method.

In providing a Works' Fire Brigade the first point is to have a commodious fire station centrally situated on the works. Fig. 21 illustrates a very efficient fire station and appliances. The station is large and has ample room for the appliances, an office is also provided for the chief officer, behind which is the watch room and a cleaning room. The appliances consist of a 45 H.P. Dennis Turbine Motor Pump, two hose carts, a 50 ft. currical fire escape and a salvage cart. No definite rule can be laid down as to exactly what appliances are required, as this can only be judged by the type of work carried on and the height and construction of the buildings.

The question of calling a fire brigade in the event of a fire is one which should receive most careful consideration. The most efficient method for a large works or establishment with a private telephone exchange, is to have this situated in the Watch Room at the Fire Station. Every telephone of the works is thereby in direct communication with the Fire Station and a call can be instantly turned in without loss of time. Fig. 22 illustrates the Watch Room, showing board provided with works' telephone, National Telephone, switches for appliance, lights, etc. Two men are always on duty day and night, this duty being taken in 8 hr. shifts, each shift doing 56 hrs. a week. Where a number of appliances are used, as in this case, some means has to be provided to indicate to the firemen on their arrival what is required. This is usually done by means of appliance lights on a board on which are a number of different coloured electric globes controlled by switches in the Watch Room. Each colour indicates an appliance, namely: red, motor pump; green, escape; blue, hose cart; yellow, salvage truck; and white, district call. The duty man switches on the light for the appliance required and the men on entering the station can see at a glance exactly what is required. The personnel of the fire brigade is another point which requires careful consideration, and it will be found advantageous to combine the watching of the factory with the fire brigade. By having twelve permanent men, divided into three shifts of 8 hours each, it is possible to have two men always on duty in the Fire Station and two men acting as watchmen in the Time Office and patrolling the buildings, etc., as required. Independent of this there should be a staff of twenty-two thoroughly trained firemen who are engaged on various work throughout the factory. To call these men, a system of fire bells should be installed throughout the works, one being in each department, and if cottages are provided for the firemen in close proximity to the works, a bell carried on to each house. These bells are, of course, controlled from the Watch Room in the Fire Station, and by this method at least four men can always be available instantly to attack a fire, while the others are in attendance in a very short space of time. Where firemen are not provided with cottages close to the works, a steam or electric hooter should be used, an electric bell being connected from the Watch Room to the Power House, and on this bell being rung the hooter is immediately sounded. Where men are on duty day and night it is necessary to provide some means for them to rest, and Fig. 23 illustrates trestles for the men to sleep on, which can be folded up and placed on one side during the day time.

The proper method of hanging and keeping the uniforms is one that should be considered carefully. Fig. 24 illustrates a very useful method. The helmets and belts are hung on the top hook, the tunic on the lower hook and the top boots with the overall leggings on them are suspended below. Care should be taken that firemen's top boots are never kept standing on the ground as they become stiff round the ankles, and most uncomfortable to wear. The adoption of overall leggings cannot be too strongly recommended. Men turning out from their departments during the day-time can slip on the top boots, pull up the overall leggings and they are equipped as respectable firemen, it does not matter what coloured or kind of trousers they may have on at the moment. Nothing looks worse than to see a fireman with tunic, helmet, belt and top boots on, and perhaps brown trousers. Whereas, with the adoption of these leggings this difficulty is not only overcome, but the man's trousers are prevented from getting dirty, his legs are kept dry and they are decidedly warm in winter. Fig. 25 illustrates a very easy method of suspending the overall leggings. A small loop with a button on the end is just passed round the man's braces and the button slipped through the loop. By this method they can be secured in a fraction of a second. Fig. 26 gives a good idea of how the men look when turned out from their departments and put into uniform instantly, by means of the overall waterproof leggings, although wearing their ordinary trousers. The adoption of squad drill cannot be too strongly recommended, say 10 mins. in every drill should be devoted to this. It tends to make the men smart, promotes discipline and they become a credit to themselves and the fire service generally. At official functions nothing looks worse than to see men on parade who cannot march or drill properly. In attending parades, demonstrations, etc., which fire brigades are frequently asked to do, one unfortunately frequently sees a party attending on their manual, steamer, motor pump, etc., as the case may be, with perhaps one in full uniform, another with tunic and cap, and perhaps a civilian in between with just a fireman's cap on. Such procedure tends to lower the dignity of the fire service and is strongly to be deprecated. In attending these parades the appliances should not be overloaded with men, but should have, say, six all told, each man being dressed alike and in full uniform. Smoking during the time that the brigade are taking part in the procession should be most strongly prohibited.

In drilling a brigade one of the first and most important things to be considered is the firemen's lift. This is very frequently neglected, but a good method of going through this drill is to do so at the completion of squad drill, the front rank being turned about and made to pick up the rear rank, and then the rear rank pick up the front rank.

Fig. 28 illustrates the works' salvage truck. This has proved a most efficient and useful appliance, as it can be turned out to deal with every question of water damage, which in a large works must of necessity occur from time to time. This salvage truck is, as will be seen in Fig. 29, most completely equipped with white waterproof sheets for covering up the stock and plant, swabs for damming up doorways, galvanized scoops for scooping up the water, brooms and squeegees for clearing away water, white cloths and waste for cleaning down machinery, etc., axes, spades, shovels, lines, and four sacks of sawdust. This whole gear, which cost approximately £100 (pre-war), has already saved several thousand pounds. Fig. 30 illustrates a method of using the scoops in clearing up the water, the swabs are laid round to form a dam into which the water is swept, it is then scooped up into pails and carried outside.

Fig. 31 gives a good idea of the equipment of the Dennis 45 H.P. Turbine Motor Fire Pump which carries 30 ft. of suction pipe, 20 ft. direct coupled, and a spare 10 ft. length on the off side. A basket strainer is most necessary when pumping is likely to take place from rivers or ponds. A 17 ft. 6 in. to 30 ft. Ajax extension ladder is carried on the gallows, also two hook ladders; below is one hook ladder folded and two scaling ladders. It is far better to carry branches, standpipes, extinguishers, breechings, etc., on pins as illustrated, where they can be instantly seen, than stowed away in the hose box or other compartment of the motor. The suction, as will be seen, is carried direct coupled to the motor; this saves considerable time when getting to work and if brought round in a good sweep is not detrimental to the suction. Fig. 32 is a near side view of the pump, which shows the method of stowing the hose box with hose rolled on the bight, and also a small invention, namely, the provision of an electric lamp on the roof of the hose box controlled by a small switch on either side. When working at night, by switching on this light the exact position of everything in the hose box is at once seen. In the smaller compartment is shown the various adaptors for converting from round thread to instantaneous, V. thread to instantaneous, instantaneous to sure lock and vice versa. Fig. 33 illustrates a view of the off-side motor pump, and again the inside of the hose box can be clearly seen with a light inside. In the smaller compartments are carried the nozzles of various different sizes, each one on a peg of its own. In this compartment is also carried a small inspection lamp on a wandering lead. This will be found most useful when working at night. The lead should be long enough to enable the lamp to reach to any part of the motor and, of course, is connected either to the accumulators or lighting set as the case may be. Fig. 34 illustrates the usual method of getting to work direct from the hydrant. On the end of the suction is carried a small length of direct suction adaptor which reduces the size of the suction down to that of the stand pipe to which it can be directly connected. By this method one is able to get the entire available water supply from the hydrant without wasting any water, as is so frequently the case when working from a dam. Care must be taken to see that the vacuum as recorded on the gauge does not exceed 15 in. or damage may be done to the water mains. Fig. 35 illustrates the method of working from a double hydrant, or three if necessary, by means of a collecting head, the suction being removed and this being screwed on direct. One, two or three lines of hose can then be connected up from various different hydrants if the water supply is poor and the mains are of a small size. This collecting head is most useful when motor pumps are working in series. For instance, it has been found that a suitable distance for motor pumps to be apart when working in series is approximately 450 yards: two lines of hose are taken from the delivery of one pump and connected up direct to the suction of the next. By this means, providing there are enough pumps, there is no limit to the distance over which water can be pumped, and three efficient jets obtained at the fire. The desirability of having a good light with which to work at fires at night is of great importance, and where gas mains have been severed it is not always possible to utilize water lights, flares, etc., neither can most brigades afford to have a special emergency tender for this purpose. Fig. 36 illustrates how this difficulty can be got over by means of utilizing the electric head-lights of the motor. A small tripod is made on which to fix the lamp; this is on a swivel so that the light can be directed in any direction, and is connected up by means of a long lead to the motor. In this case it is 20 yards long so that both lamps can be got to work 20 yards from the pump, or one lamp 40 yards from the pump. Fig. 37 illustrates a very useful and inexpensive method of improvising a cellar pipe—the nozzles of an ordinary branch being removed and a small brass elbow fixed on with a nozzle at right angles, then lashed to a scaling ladder. This can be let down through the cellar flap or other opening, and by moving the ladder the jet can be directed in any direction without descending into the cellar. A most useful appliance is illustrated in Fig. 38 and is a hose suspension elbow with an 18 in. flexible leather branch. Instead of the old method of taking a line of hose up a ladder and lashing it on, it is connected to the suspension elbow, the hook on same is hooked over the rung of the ladder and the leather strap is strapped round the rung below to prevent it coming off. Fig. 39 illustrates it in use; it can be used on any ladder or escape, the man operating it being secured by means of a belt on a hook ladder. The top of the suspension elbow having a swivel joint, one is able to direct the jet in any direction, while the weight of the hose is taken up by means of the hook. In this case it is not advisable to have the man standing on the same hook ladder as that to which the hose is secured. Another use to which this elbow can be applied, is in taking a line of hose across the roof; it takes the weight of the line and hose coming up the ladder, and entirely does away with the kink which usually occurs in passing over the coping.

It is most essential that the brigade at a works where a very large number of people are employed should be thoroughly trained in every method of life saving. The ordinary method of ascending and carrying a person down is, of course, well known. Fig. 40 illustrates another method. A line is taken up an escape and passed over a rung near the top, the other end being passed round the heel of the escape, and is controlled by one of the men on the ground. The fireman having hooked himself on to the end of the line, swings himself into the window, passes the sling round the inmate to be rescued, who is lowered down by the men on the ground. This can be fixed up in a very short space of time and quite a number of people speedily rescued. Fig. 41 illustrates a close view and shows a sling which is adopted in place of the old-fashioned chair knot. This is easier to fix and does not cut the patient so much as an ordinary rope. Fig. 42 shows a method of rescuing a person who is either bed-ridden, ill, or has a broken limb. The ordinary scaling ladder is taken up, one sling passed round the feet and one round the shoulders and hooked on to the end of the line. Fig. 43 is a closer view which practically explains itself. The patient can be lowered to the ground without the slightest jar, in fact, almost as easily as being passed down in a lift. Fig. 44 illustrates a method of using hook ladders—the first man hooks a ladder on to the sill, ascends, sits on the sill and pushes the ladder up to the next sill. He then ascends and hooks himself to the top rung. The next man hooks his ladder to the first sill, ascends, passes his ladder up to the first man who pushes it on to the floor above. By this means the men are thoroughly trained to either go any height singly or in pairs. On reaching the required height the bobbin is immediately dropped; this is carried in a small leather pouch at the back of the belt and is released by pulling down the flap. On reaching the ground the heavy lines and slings are immediately made fast, pulled up and secured. A very speedy and efficient method of rescuing will be found in using two lines as illustrated in Fig. 45. A sling is passed round the person to be rescued and the hook passed over both lines, the lines are held secure and well apart on the ground and act as a guide line and a break at the same time. When slightly slackened out, the person to be rescued gently slides down the line. Fig. 46 illustrates the method of rescuing a person who is infirm or with broken limbs—two slings are again used as with the escape, but in this case both hooks are passed over both lines. No difficulty is experienced providing the lines are made fast, either over the top of the window which you are operating from, or from the roof or room above.

In conclusion the carrying out of these suggestions may be looked upon as entailing a somewhat heavy initial expense, but in reality the security thus obtained will more than compensate the amount expended. Firms who are thinking of undertaking such protection would be well advised to secure the services of a thoroughly proficient energetic fire brigade officer who would be able to advise them upon the special conditions existing on their premises and who would be able to personally supervise and organize the whole fire protection for them.

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